



GUIDE FOR BUILDING AND CLASSING

LNG REGASIFICATION VESSELS

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Foreword

The industry and ABS share a large and successful body of experience with Liquefied Natural Gas (LNG) carriers.

This Guide provides criteria that can be applied to LNG Carriers and LNG Barges proposed to be classed by utilizing the *ABS Rules for Building and Classing Steel Vessels* and/or *ABS Rules for Building and Classing Steel Barges* and fitted with regasification systems and components.

Floating storage and regasification units (FSRUs) provide solutions to meet the energy demands of an ever-changing global market. Floating regasification is a flexible, cost-effective way to receive and process shipments of LNG. Floating regasification is increasingly being used to meet natural gas demand in smaller markets, or as a temporary solution until onshore regasification facilities are built. Floating regasification involves the use of a specialized vessel often referred to as an FSRU, which is capable of transporting, storing, and regasifying LNG onboard. An FSRU can be purpose-built or be converted from a conventional LNG vessel by installing a regasification plant.

Regasification plants are installed to vaporize the liquid gas onboard a vessel, this may include self-propelled LNG carriers or Non-Self-Propelled LNG barges. The gas may be delivered to the shore side facility via various arrangements, such as turret system with delivery through an offshore buoy piping system or vessel manifold system to facility on platform, quay or similar.

This Guide is to be used in conjunction with other ABS Rules and IMO Regulations.

This Guide is for the use of designers, builders, owners and operators of liquefied gas carriers/tank barges and specifies the ABS requirements for obtaining the optional classification notation **(LNG) R**.

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.



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SECTION 1 Scope and Conditions of Classification

1 Scope and Application

This Guide has been developed to provide guidance for the design, construction, and survey of Liquefied Natural Gas (LNG) vessels utilizing regasification systems. The Guide focuses on systems and arrangements provided for the safe delivery of natural gas by means of regasification systems. The Guide applies to LNG vessel types that fall under the scope of the IGC Code and associated ABS requirements for Vessels Intended to Carry Liquefied Gases in Bulk under Part 5C, Chapter 8 of the *ABS Rules for Building and Classing Steel Vessels (Steel Vessel Rules)* or the *ABS Rules for Building and Classing Steel Barges (Barge Rules)*.

In general, vessels are to comply with the requirements contained in the ABS requirements for Vessels Intended to Carry Liquefied Gases in Bulk under Part 5C, Chapter 8 of the *Steel Vessel Rules* or the *Barge Rules*, as applicable, and the requirements of this Guide to receive the notations listed in Section 1/3.

This Guide applies to both new construction and existing vessel conversions, regardless of size, utilizing regasification systems.

3 Classification Notations

Vessels that comply with this Guide and are intended to operate in a regasification and gas discharge role, are eligible for ABS classification which will be denoted with the additional notation **(LNG) R**, so that the class notation as it appears in the *Record* will be:

✘ A1 Liquefied Gas Carrier, (LNG) R or **✘ A1 Liquefied Gas Tank Barge, (LNG) R**

5 Definitions

The definitions contained in 5C-8-1/2 of the *Steel Vessel Rules* are applicable. The following definitions are applied to the terms used in this Guide:

Cargo Machinery Spaces. The spaces where cargo compressors or pumps, cargo processing units, are located, including those supplying gas fuel to the engine-room.

Floating Storage and Regasification Unit (FSRU). A vessel that has LNG storage as well as regasification equipment for LNG vaporizing.

Gas Process Unit. Booster pumps, process pressure vessel, regasification plant.

Regasification Plant. All systems and components for removing liquefied gas from the storage tanks, pressurizing, heating and vaporizing liquefied gas and discharge ashore of vaporized gas through an off-loading system. If there are compressors or odorizers in the discharge system, they would be considered part of the Regasification Plant.

Turret Compartments. Those spaces and trunks that contain equipment and machinery for retrieval and release of the disconnectable turret mooring system, high-pressure hydraulic operating systems, fire protection arrangements and cargo transfer valves.

Upset Condition. Interruptions in the regular running of the work process or other planned activity. Any distraction or break in the normal work routine is considered an Upset Condition.

7 Materials of Construction

Materials in general are to comply with the requirements of the *ABS Rules for Materials and Welding (Part 2)*.

Materials used in gas tanks, gas piping, process pressure vessels, and other components in contact with cryogenic liquids or gases are to be suitable for the intended purpose and in compliance with Section 5C-8-6 of the *Steel Vessel Rules*.

9 Certification

Design review, survey, testing, and the issuance of reports or certificates constitute the certification of machinery, equipment and systems; see also 4-1-1/3 of the *Steel Vessel Rules*.

11 Alternatives

Equipment, components, and systems for which there are specific requirements in this Guide, or its associated references, may incorporate alternative arrangements or comply with the requirements of alternative recognized standards, in lieu of the requirements in this Guide. These alternative arrangements or standards are to be determined by ABS as being not less effective than the overall safety and strength requirements of this Guide or associated references. Where applicable, requirements may be imposed by ABS in addition to those contained in the alternative arrangements or standards so that the intent of this Guide is met. In all cases, the equipment, component or system is subject to design review, survey during construction, tests and trials, as applicable, by ABS for purposes of verification of its compliance with the alternative arrangements or standards. The verification process is to be to the extent as intended by this Guide.



SECTION 2 Vessel Arrangements and System Design

1 Application

The requirements specified in this Section provide general guidance on ship arrangements and regasification plant design.

3 Plans and Data to be Submitted

The following regasification plant plans, calculations and information, as applicable, are to be submitted in addition to those required by 4-1-1/5.3 and 5C-8-1/5 of the *Steel Vessel Rules*, as applicable:

- General arrangement of the regasification plant
- Hazardous area arrangement
- Booklet of installations in classified hazardous areas
- Risk assessment
- Operational manual
- Scantlings and details of foundation drawing in way of regasification and power generation modules
- Strength analysis document in way of regasification and power generation modules.
- Cargo containment and Pump Tower strength analysis (sloshing)
- Escape routes
- Project specification and overall process concept description
- Machinery arrangement of regasification plant and power generation system
- Ventilation system for compartment of cargo machinery space and turret, if applicable
- Cryogenic spill containment
- Failure Modes and Effects Analysis (FMEA) (As required by Subsection 2/19)
- Emergency shutdown (ESD) system
- ESD Cause and effect diagram
- Fire and gas detection and alarm systems
- Fire extinguishing systems
- Piping and Instrumentation Diagram (P&ID)
- Piping material specification
- Process Flow Diagram (PFD)
- Piping arrangement
- Pipe stress analysis (high pressure and cryogenic)

- Details of all cargo and vapor handling equipment including high pressure system
- Details and installation of the safety valves/blow down valves and capacity calculations
- Inert-gas system
- Pressure relief and blowdown calculations
- Mooring details and specification
- Regasification plant testing procedures

5 Risk Assessment

A risk assessment is to be submitted for ABS review per requirements in IGC Code 1.1.10.

5.1 Assessment Criteria

A risk assessment is to be carried out to identify significant hazards and accident scenarios that may affect the installation or any part thereof, and consider the benefit of existing or potential risk control options.

The objective of the risk assessment is to identify areas of the design that may require the implementation of risk control measures to reduce identified risk(s) to an acceptable level.

The risk assessment is to be conducted by using recognized techniques as described by 5C-8-1/1.11 of the *Steel Vessel Rules*. The identified risk control options (prevention and mitigation measures) deemed necessary to be implemented is to be considered part of the design basis of the vessel.

The overall criteria is that systems and equipment be designed to minimize the risk of hazards to personnel, property and environment. Implementation of this criteria to regasification plants and the associated systems is intended to:

- i) Prevent an abnormal condition from causing an upset condition
- ii) Prevent an upset condition from causing a release of hydrocarbons or cryogenic fluids
- iii) Safely collect and dispose of hydrocarbon or cryogenic fluids released
- iv) Prevent formation of explosive mixtures
- v) Prevent ignition of flammable liquids or gases and vapors released
- vi) Limit exposure of personnel to fire and cryogenic hazards

Hazards to be addressed by the risk assessment in addition to 5C-8-1/10 of the *Steel Vessel Rules* are to include:

- Pressurized gas discharge to shore
- High pressure gas venting
- Storage and handling of flammable refrigerants (as applicable)
- Ship-to-ship transfer of liquid cargo
- Fire propagation from turret compartments
- Turret compartments structural integrity in case of explosion or uncontrolled high-pressure gas release (overpressure and/or brittle fracture)
- Loss of ability to offload liquefied gas or discharge gas ashore
- Loss of any one critical component in the process system
- Loss of electrical power
- Escape routes

ABS recommends that early in the project a risk assessment plan be developed, documented and submitted to ABS for review prior to conducting the risk assessment. During review of the plan, an agreement will be reached on the extent of ABS participation and/or monitoring of project-related risk studies. ABS's participation in and/or monitoring of key tasks (e.g., Hazard Identification meetings) is necessary in order to establish a minimum level of confidence on the risk assessment results.

Previously conducted risk assessments may have resulted in documentation of a risk model that is pertinent to the design and operation being proposed. If an applicable risk model is available, its use may be considered where proposed in the project risk assessment plan. Further guidance for incorporating the use of an existing risk model is addressed in Section 5 of the *ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities*.

The *ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities* contains an overview of the risk assessment process. *ABS Guidance Notes on Risk Assessment Application for the Marine and Offshore Oil and Gas Industries* contain an overview of risk assessment techniques and additional information.

7 Mooring

Plans are to include the site location showing the berthing arrangements, mooring location and mooring configuration. Unless the vessel is to be moored hard up to the berth, the geographic location of the vessel is required to be specified. The mooring system and fender loads are to be assessed and considered while specifying limitations on cargo transfer operation. If a turret or spread mooring arrangement is utilized, the requirements in Chapter 6 of the *ABS Rules for Building and Classing Floating Production Installations* are to govern the FSRU mooring system. For jetty mooring, details of the site-specific design of the FSRU mooring system and components are to be submitted for information.

9 Turret Compartment Arrangements

9.1 Structural Fire Protection

Structural fire protection for turret compartments is to be provided in accordance with 5C-8-3/1.4 and 5C-8-3/3.1 of the *Steel Vessel Rules*.

9.3 Fire Propagation

The risk of fire propagation from turret compartments to adjacent spaces is to be evaluated by a risk analysis. Further preventive measures, such as the arrangement of a cofferdam around the turret compartment, are to be provided if needed.

9.5 Explosion or Uncontrolled High-pressure Gas Release

Turret compartments are to be designed to retain their structural integrity in case of explosion or uncontrolled high-pressure gas release (overpressure and/or brittle fracture), the characteristics of which are to be substantiated on the basis of a risk analysis with due consideration of the capabilities of the pressure relieving devices. Blast relief panels may be provided.

11 Sloshing

The vessel's operating profile in a regasification mode will involve a full range of loaded conditions from full to empty. The suitability of the vessel's hull structure, containment system, and other in-tank components such as pump tower are to be reviewed for the sloshing loads based on the site-specific condition where the vessel will operate as an FSRU. Any special considerations to environmental limitations, operating restrictions, and mitigating measures as associated with sloshing is to be included in the operations manual.

13 Regasification System and Equipment

13.1 General

13.1.1 General

The regasification plant piping system and associated components are to comply with Section 5C-8-5 of the *Steel Vessel Rules*. The following standards may be suitable for the assessment of regasification equipment:

- ASME B31.3 – Process Piping
- API RP 14E – Design and Installation of Offshore Production Platform Piping Systems

13.1.2 Valves

All valves necessary for cargo handling are to be readily accessible to personnel wearing protective clothing.

13.1.3 Pipe Stress Analysis

A pipe stress analysis is to be carried out for high pressure and cryogenic piping associated with the regasification plant, taking into account all the stresses due to weight of pipes, including acceleration loads if significant, internal pressure, thermal contraction and loads induced by hog and sag of the ship for each branch of the piping system.

13.1.4 Spill Containment

Spill containment is to be provided where liquid piping is dismantled regularly, or where liquid leakage may be anticipated to prevent the temperature of the structure from falling below the design temperature of the structure material.

13.3 Pressure Vessels

Pressure vessels are to comply with 5C-8-5/1 of the *Steel Vessel Rules*.

The following standards may be suitable for assessment of regasification equipment:

- ASME Boiler and Pressure Vessel Code Section VIII Div. 1; or Section VIII Div. 2
- Standards of Tubular Exchanger Manufacturers Association
- API Std. 660 – Shell-and-tube Heat Exchangers

Other national standards or codes will be considered, provided that they are no less effective.

13.5 Pumps

Each size and type of pump is to be approved through design assessment and prototype testing in accordance with 5C-8-5/13.1.3 of the *Steel Vessel Rules*.

The following standards may be suitable for assessment of regasification equipment:

- ISO 13709 – Centrifugal pumps for petroleum, petrochemical and natural gas industries
- ISO 24490 – Cryogenic vessels – Pumps for cryogenic service
- API Std 610 – Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

13.7 Compressors

Compressors are to be suitable for their intended purpose. All equipment and machinery is to be adequately designed for use within a marine environment. Each size and type of compressor is to be design assessed and prototype tested in accordance with 5C-8-5/13.1.4 of the *Steel Vessel Rules*.

The following standards may be suitable for assessment of regasification equipment:

- API Std 617 – Axial and Centrifugal Compressors and Expander-compressors for Petroleum, Chemical and Gas Industry Services
- API Std 618 – Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services
- API Std 619 – Rotary-Type Positive-Displacement Compressors for Petroleum, Petrochemical, and Natural Gas Industries

13.9 Pressure Relief and Venting System

Pressure safety relief valves and venting arrangements and locations are to comply with Section 5C-8-8 of the *Steel Vessel Rules*. Pressure losses upstream and downstream of the PRVs are to be taken into account when determining their size as required by 5C-8-8/4.1 and 5C-8-8/4.2 of the *Steel Vessel Rules*.

The outlet from pressure relief valves in LNG piping or in vapor piping which could see LNG in any failure mode is to be specially considered during the risk assessment so that the passing of LNG will not create a downstream hazard which has not been fully considered in the design and safety features.

The following standards may be suitable for assessment of regasification equipment:

- ASME Section VIII, Division 1 Appendix M.
- API Std 520 – Sizing, Selection, and Installation of Pressure-relieving Devices
- API Std 521 – Pressure-relieving and Depressuring Systems

13.11 Depressurization/Blowdown system

The regasification plant is to be provided with a blow down system (vapor depressuring) to limit the consequences of equipment and piping failure during emergency conditions. Vapor depressuring should follow the design principles in API 521.

- i)* Manual activation of the blowdown system is to be provided.
- ii)* Automatic activation of the blowdown system is to be provided if required to safely perform an emergency function as associated with ESD functions as identified the risk assessment, (e.g. emergency buoy release (where fitted), loss of ESD valve actuating medium, fire detection, and emergency push buttons).
- iii)* The blow down valves are to be fail safe.
- iv)* Activation of blow down system is to be provided with visual and audible alarm in cargo control room and in cargo area to alert crew.

13.13 Turret Compartment Transfer Systems

For the transfer of vapor cargo through an internal turret arrangement located outside the cargo area, the piping serving this purpose is to comply with 5C-8-5/2.2 of the *Steel Vessel Rules*, as applicable, and the following:

- i)* Piping is to be located above the weather deck, except for the connection to the turret; Portable arrangements are not permitted.
- ii)* Arrangements are to be made to allow such piping to be purged and gas-freed after use. The vent pipes connected with the purge are to be located in the cargo area.
- iii)* Cargo piping and related piping equipment outside the cargo area is to have only welded connections.
- iv)* The piping is to be full penetration butt-welded, and subjected to full radiographic or ultrasonic inspection, regardless of pipe diameter and design temperature. Flange connections in the piping are to only be permitted within the cargo area and at connections to cargo hoses and the turret connection.

15 Electrical Systems and Installations

Electrical installations are to be in accordance with the applicable requirements of Part 4, Chapter 8 and Section 5C-8-10 of the *Steel Vessel Rules*.

15.1 Hazardous Areas

Hazardous areas are defined by 5C-8-1/2.24 of the *Steel Vessel Rules*. Hazardous area zoning is to be defined in accordance with 5C-8-10/1.1 of the *Steel Vessel Rules* and IEC 60092 -502: 1999.

Consideration is to be given to the risk assessment conducted and possible additional identified electrical hazards and extending extent of hazardous areas

15.1.1 Permanent Notice and Booklet of Certified Safe Equipment

A booklet containing the list of certified safe equipment, as installed, along with the particulars of the equipment (refer to 4-8-1/5.3.2 of the *Steel Vessel Rules*), is to be maintained onboard. Permanent notices are to be posted in the vicinity of hazardous areas in which such electrical equipment is installed to advise the crew of the availability of the booklet so that it can be referenced during repair or maintenance.

17 Fire Safety

Fire Safety is to be provided in accordance with applicable statutory conventions and Section 5C-8-11 of the *Steel Vessel Rules*.

17.1 Water Spray System

Regasification Plant positioned on deck are to be protected by a water spray system in accordance with 5C-8-11/3 of the *Steel Vessel Rules*.

This is to include but not limited to:

- Gas process units
- Suction drum
- Recondenser
- Transfer manifold
- Emergency Shutdown Valves
- Turret compartment internal surfaces

Where a turret is fitted, turret compartments are to be protected by internal water spray, with an application rate of not less than 10 l/m²/min (0.24 gpm/ft²) of the largest projected horizontal surface. If the pressure of the gas flow through the turret exceeds 4 MPa, the application rate is to be increased to 20 l/m²/min (0.48 gpm/ft²). The system is to be designed to protect all internal surfaces.

17.3 Dry Chemical Powder Fire-extinguishing Systems

Dry chemical powder fire-extinguishing systems are to be provided as required by 5C-8-11/4 of the *Steel Vessel Rules*.

The system is to be capable of delivering powder from at least two hand hose lines or a combination of monitor/hand hose lines, to any part of the exposed cargo liquid and vapor piping, load/unload connection and exposed gas process units.

17.5 Ventilation

Cargo machinery spaces and turret spaces are to be fitted with fixed artificial ventilation systems capable of being controlled from outside such spaces as per Section 5C-8-12 of the *Steel Vessel Rules*. The ventilation is to be run continuously to prevent the accumulation of flammable vapors, with a means of monitoring.

Lighting in cargo machinery spaces and turret compartments, except emergency lighting, is to be interlocked with ventilation such that the ventilation is to be in operation when switching on the lighting. Failure of the ventilation system is not to cause the lighting to go out.

17.7 Fire Detection System

Fire and Gas Detection and Alarm Systems are to be provided for weather decks of the cargo area and/or cargo machinery spaces and/or turret compartments in accordance with 5C-8-18/10.3.2 and 5C-8-18/Table 1 of the *Steel Vessel Rules*.

The fire detectors should be suitable for high pressure jet fires in the areas of the gas process unit, high pressure piping, transfer manifolds, and turret compartments.

17.9 Gas Detection System

Gas detection systems are to be provided in accordance with 5C-8-13/6 of the *Steel Vessel Rules*. Continuous measurement is to be provided for the following areas:

- Regasification units
- Turret Compartment
- High Pressure Gas Export manifold
- Heating system routed through a non-hazardous area
- Other spaces identified by Risk Assessment (as applicable)

19 Instrumentation and Control Systems

- i) Instrumentation and Automation Systems are to be provided in accordance with Section 5C-8-13 of the *Steel Vessel Rules*.
- ii) The regasification plant control and monitoring system may be connected to an integrated control system or be a stand-alone system.
- iii) A Failure Modes Effects Analysis (FMEA) is to be carried out for the regasification plant control system identifying component criticality in accordance with 5C-8-13/9 and Section 4-9-4 of the *Steel Vessel Rules*.
- iv) The regasification plant control and monitoring system design is to meet the single failure criteria (i.e., no single control system component failure or single fault condition is to result in an unsafe situation).

For further guidance on implementing FMEA requirements for classification purposes, refer to the *ABS Guidance Notes on Failure Mode and Effects Analysis (FMEA) for Classification*.

The following standards may be suitable for assessment of regasification equipment:

- ISO 10418 – Petroleum and Natural Gas Industries – Offshore Production Installations -- Analysis, Design, Installation and Testing of Basic Surface Process Safety Systems
- API RP 14C – Analysis, Design, Installation and Testing of Basic Surface Safety Systems for Offshore Production Platforms

21 Emergency Shutdown (ESD) System Control

An emergency shutdown system is to be provided in accordance with 5C-8-18/10 and 5C-8-18/Table 1 of the *Steel Vessel Rules*. Other ESD system controls identified by Risk Assessment, as applicable, are to be provided.

A cause and effect diagram is to reflect:

- i) Cause inputs that initiate the automatic shutdown effect output
- ii) Parameters (set points) that trigger the cause
- iii) Action item of the effects (e.g. valve closure, machinery shutdown)

The following standards may be suitable for assessment of regasification equipment:

- API RP 14C - Analysis, Design, Installation and Testing of Basic Surface Safety Systems for Offshore Production Platforms

23 Cargo Operations Manuals

The cargo operation manual as required by Section 5C-8-18 of the *Steel Vessel Rules* is to be provided and include the regasification plant. The vessel is to be provided with copies of suitably detailed cargo system operation manuals.

Detailed instruction manuals are to be provided onboard, covering the operations, safety and maintenance requirements, personal protective equipment and occupational health hazards relevant to the use of the regasification plant. The operational parameters of all systems and components for removing liquefied gas from the storage tanks, pressurizing, heating and vaporizing liquefied gas and in some cases odorizing the liquefied gas vapor and discharge ashore of vaporized gas through an off-loading system are to be addressed in the manual. The content of the manuals is to include, but not be limited to:

- Information regarding the cargo system and associated systems as detailed by 5C-8-18/2.2 of the *Steel Vessel Rules* as applicable to the regasification plants
- System limitations, including minimum temperatures, maximum pressures, transfer rates; details of depressurization and high pressure blow-down philosophy and arrangements; gas piping systems including details of pipes and associated components, design pressures and temperatures
- Descriptions and schematic diagrams for control and monitoring system including set points for abnormal conditions
- Details of all electrical equipment in the regasification plant compartment
- Emergency shutdown arrangements, cause and effects
- Mooring Arrangement and Philosophy
- Environmental limitation and operating restrictions as associated with sloshing



SECTION 3 Surveys

1 Surveys During Installation and Trials

This Section pertains to surveys during installation and trials of a regasification system. The requirements here are in addition to those established in Part 5C, Chapter 8 and Part 5C, Chapter 12 of the *Steel Vessel Rules*.

1.1 Surveys During Installation

The following surveys are to be carried out to the satisfaction of the attending Surveyor on the regasification plant during installation and testing are to include but not limited to:

- i) Piping systems, pressure vessels, and equipment are to be examined and tested, as required by the *Steel Vessel Rules*.
- ii) Electrical wiring and connections are to be in accordance with Part 4 of the *Steel Vessel Rules* and checked for continuity and proper workmanship.
- iii) Instrumentation is to be tested to confirm proper operation as per its predetermined set points.
- iv) Pressure relief and safety valves installed on the unit are to be tested.
- v) Control system and shutdowns are to be tested for proper operation.

1.3 Surveys During Trials

During the initial trials, the regasification plant is to be confirmed for its satisfactory operation, including associated controls, alarms and shutdowns. The tests are to be conducted to the satisfaction of the attending ABS Surveyor during trials.

3 Surveys After Construction and Maintenance of Class

This Section pertains to periodical surveys after construction for the maintenance of classification for Floating Storage and/or Regasification vessels.

The surveys after construction for Floating Storage and/or Regasification vessels are to be in accordance with the applicable requirements for a Liquefied Gas Carrier, including any notations, as contained in the *ABS Rules for Survey After Construction (Part 7)* except as noted in the following.

3.1 Drydocking Survey

3.1.1 Underwater Inspection in Lieu of Drydocking (UWILD)

Underwater inspection equivalent to a Drydocking Survey may be carried out at each Drydocking Survey up to and including Special Survey No. 4 using the UWILD plan previously agreed by the Assistant Chief Surveyor's (ACS) Office, provided the flag administration is in concurrence with same with regard to the statutory certificates issued on their behalf. When a Floating Storage/Regasification vessel exceeds the normal out of the water drydocking, a Record Comment will be added to the vessel record to indicate the requirements of 3/3.1.2. The underwater inspection is to be carried out in accordance with this Section.

For each drydocking after Special Survey No. 4, requests to carry out the UWILD in accordance with previously approved plans are to be submitted for consideration to the respective offshore ACS Office well in advance of the proposed survey. Approvals to carry out the UWILD after Special Survey No. 4 are to be made available onboard for the Surveyor's reference.

3.1.2 Return to Drydock

Upon completion of the storage and/or regasification service, the vessel is required to proceed to drydock for an out of water drydocking survey if the vessel has been in floating storage and/or regasification service for five years or more since the last out-of-the-water docking.

Voyages off site to temporarily avoid weather events that are projected to meet or exceed the design limits of the fixed mooring system do not require out of water drydocking provided the vessel returns to the site without resuming trading.

3.1.3 Conditions

3.1.3(a) Limitations. UWILD may not be acceptable where there is record of abnormal deterioration or damage to the underwater structure, or where damage affecting the fitness of the vessel is found during the course of the survey.

3.1.3(b) Thickness Gauging and Nondestructive Testing. Underwater or internal thickness gaugings of suspect areas may be required in conjunction with the underwater inspection. Means for underwater nondestructive testing may also be required for fracture detection.

3.1.3(c) Plans and Data. Approved plans and procedures for the survey are to be made available onboard for the purpose of carrying out an onboard preplanning of the survey with the Surveyor. These should include nomenclature of underwater parts and drawings or forms for laying out the areas to be surveyed, the extent of hull cleaning, nondestructive testing locations (including NDT methods) and for mapping damage or deterioration found. The examination of items associated with the Special or Continuous Surveys and Tail Shaft Surveys is to be included in the plans.

3.1.3(d) Underwater Conditions. The areas to be surveyed are to be sufficiently clean and the sea water clear enough to permit meaningful examination and photography (if necessary) by the diver. Overall or spot cleaning may be required by the attending Surveyor.

3.1.4 Physical Features

The following physical features are to be incorporated into the vessel's design in order to facilitate the underwater inspection. When verified, they will be noted in the vessel's Classification for reference at subsequent surveys.

3.1.4(a) Stern Bearing. Means are to be provided for ascertaining that the seal assembly on oil-lubricated bearings is intact and for verifying that the clearance or wear-down of the stern bearing is not excessive. For oil-lubricated bearings, this may only require accurate oil-loss-rate records and a check of the oil for contamination by sea water or white metal. For wood or rubber bearings, an opening in the top of the rope guard and a suitable gauge or wedge would be sufficient for checking the clearance by a diver. For oil-lubricated metal stern bearings, wear-down may be checked by external measurements between an exposed part of the seal unit and the stern tube bossing, or by use of the vessel's wear-down gauge, where the gauge wells are located outboard of the seals, or the vessel can be trimmed. For use of the wear-down gauges, up-to-date records of the base depths are to be maintained onboard. Whenever the stainless steel seal sleeve is renewed or machined, the base readings for the wear-down gauge are to be re-established and noted in the vessel's records and in the survey report.

3.1.4(b) Rudder Bearings. Means and access are to be provided for determining the condition and clearance of the rudder bearings, and for verifying that all parts of the pintle and gudgeon assemblies are intact and secure. This may require bolted access plates and a measuring arrangement.

3.1.4(c) Sea Suctions. Means are to be provided to enable the diver to confirm that the sea suction openings are clear. Hinged sea suction grids would facilitate this operation.

3.1.4(d) Sea Valves. Means are to be provided to examine any sea valve for the UWILD associated with the Special Survey.

3.1.5 Procedures

3.1.5(a) Exposed Areas. An examination of the outside of the structure above the waterline is to be carried out by the Surveyor. Means and access are to be provided to enable the Surveyor to accomplish visual inspection and nondestructive testing, as necessary.

3.1.5(b) Underwater Areas. An examination of the entire vessel below the waterline is to be carried out by a suitably qualified diver using closed-circuit television with two-way communication capable of being monitored by the Surveyor, as required, or photographic documentation, or both, depending on the age and type of vessel. This is to be supplemented by the diver's report, describing and attesting to the conditions found. A copy of this diver's report and pertinent photographs is to be submitted to the attending Surveyor for retention at the local office for five (5) years. Copies are also to be retained onboard, together with any video recording, for reference.

3.1.5(c) Damage Areas. Damage areas is to be photographed. Internal examination, measurements, marking and thickness gauging of such locations may be a necessary adjunct as determined by the attending Surveyor. Means are to be provided for locating, orienting and identifying underwater surfaces in photographs or on video tapes.

3.3 Tail Shaft Surveys

Due to low running hours on tail shafts of Floating Storage and/or Regasification vessels, the interval between tail shaft surveys may be extended if the Surveyor is satisfied with the following:

- i)* Diver's external examination of stern bearing and outboard seal area, including wear-down check as far as is possible
- ii)* Internal examination of the shaft area (inboard seals) in the engine room(s)
- iii)* Confirmation of lubricating oil records (satisfactory oil loss rate, no evidence of unacceptable contamination)
- iv)* Shaft seal elements are examined/replaced in accordance with the seal manufacturer's recommendations