DNV·GL

CLASS GUIDELINE

DNVGL-CG-0042 Edition July 2019

Cargo vapour recovery systems

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FOREWORD

DNV GL class guidelines contain methods, technical requirements, principles and acceptance criteria related to classed objects as referred to from the rules.

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CHANGES – CURRENT

This document supersedes the November 2015 edition of DNVGL-CG-0042.

Changes in this document are highlighted in red colour. However, if the changes involve a whole chapter, section or subsection, normally only the title will be in red colour.

Changes July 2019

Topic	*Reference*	*Description*
New class notation for smaller capacity VOC recovery installations used on laden voyages only, with a recovery rate of X% non-methane volatile organic compounds	Sec.1 [1]	New requirements for smaller capacity VOC recovery installations used on laden voyages only applies to ships with class notation **VCS(L, X%)** in DNVGL-RU-SHIP Pt.6 Ch.4 Sec.11.
Amendments to existing requirements	Sec.3 [1]	Introduction of requirements to documentation showing arrangement of ventilation, gas detectors, and thermal protection or leakage protection, containment and detection as applicable based on maker's assessment of maximum probable leakage. In addition, requirements are introduced specifying that on request, process simulations dispersant analysis may be required submitted.
	Sec.4 Table 1	Valves, fittings and pump housing included in material requirements. The requirement for material certification of these items will follow the requirements for pipes. The material requirements have also been amended to include flanges and nuts and bolts.
	Sec.5 [1]	Clarified that the VL certificates required for the specified items are VL product certificates, to avoid previous confusion as to whether the requirement is for material certificates or product certificates.
	Sec.6 [1]	Added requirements to protection of steel structures such as cargo main deck from the consequences of a low temperature liquid spill.
	Sec.6 [2] and Sec.6 [3]	Added requirement to prevent the consequences of high pressure leaks in general and uncontrolled discharges into cargo systems and cargo tanks.
	Sec.9 [2] and Sec.9 [3]	Added requirement to prevent the low temperature consequences when operating at high gas pressures. Further, requirements allowing for extended gas detection were introduced for high pressure gas systems. Requirements were introduced for number and location of gas detectors in VOC process spaces.
	Sec.10 [1]	Where VOC installation involve high gas pressures (above 40 barg), requirements to dispersant analysis have been introduced for assessment of hazardous zones.

Topic	Reference	Description
	Sec.11 [3]	Requirements have been introduced to testing of vapour control and vapour recovery systems. For **VCS(3)** and **VCS(L, X %)**, the system shall include testing of the safety system in the presence of DNV GL.Verification of capability to meet the emission criteria shall be based on full scale operational test according to an approved test program. Provided a complete report is submitted to DNV GL. DNV GL is not required to be present during this testing.
	App.A Table 1	The requirements to hazardous zone classification were amended so that they follow the requirement for gas carriers.

Editorial corrections

In addition to the above stated changes, editorial corrections may have been made.

CONTENTS

SECTION 1 SCOPE

1 General

This class guideline gives requirements for cargo vapour recovery systems required to be fitted for class notation **VCS(3)** and **VCS(L, X%)** according to DNV GL rules for classification: Ships DNVGL-RU-SHIP Pt.6 Ch.4 Sec.11 *Cargo operations*, on the following working principles:

— re-absorption of cargo vapours in the liquid cargo itself
— liquefaction of cargo vapours
— other principles may be considered on a case-by-case basis.

For systems where volatile organic compounds (VOC) shall be used as gas fuel for combustion machinery, DNVGL-RU-SHIP Pt.6 Ch.2 Sec.5 *Gas fuelled ship installations,* shall be taken into account to any part of the system interfacing with such a gas fuel system. Note that the use of VOC as fuel on board ships normally also require flag administration approval.

The requirements for this class notation are additional to the requirements for main class, given in DNVGL-RU-SHIP Pt.1 to DNVGL-RU-SHIP Pt.4. App.A Table 1 shows some applicable rule references.

Refrigeration systems shall comply with the requirements given in DNVGL-RU-SHIP Pt.4 Ch.6 *Piping systems*. Where the refrigerant is a flammable medium, the refrigeration system shall comply with the requirements given in DNVGL-RU-SHIP Pt.5 Ch.7 *Liquefied gas tankers*.

The requirements shall apply to any vapour recovery system when installed onboard vessels classed with the Society.

SECTION 2 DEFINITION

1 General

A semi-open space is a space that is adequately ventilated by natural ventilation. The space shall be fully open in the aft end and at least 10% of the side areas shall be open. Alternatively, the openings in each of the three bulkheads shall constitute an area of at least 30% of the total area.

SECTION 3 DOCUMENTATION

1 General

The following plans and particulars shall be submitted:

- process description
- general arrangement plan including the location of the system main components
- schematic diagrams of piping systems, including instrumentation with information of design parameters, materials used, pipe diameters and wall thickness and specifications of fittings and components
- hazardous zones and spaces
- ventilation arrangement
- arrangement of gas detectors
- arrangement of thermal protection or leakage protection, containment and detection as applicable, including maker's assessment of maximum probable leakage
- drawings and specifications for pressure vessels including strength calculations and details of overpressure protection
- electrical installations:
  - single line diagram
  - wiring diagrams for starters
  - schematic diagrams for distribution boards
- documentation of electrical equipment in hazardous areas. The list shall include an indexing system to enable traceability of components towards other drawings and shall give information such as certificate number, type of ex protection, compatibility values for intrinsically safe circuits and also explaining connection with barriers. Copy of certificates may be required.
- instrument diagrams including description of software in the form of logic diagrams as applicable
- drawings of supports and the staying of heavy components including strength calculations
- fire-extinguishing arrangements
- structural fire protection including details of penetrations
- fire detection and alarm system
- test programme.
- procedure for inerting and gas freeing of VOC plant
- operation manual
- cause and effect diagram for control, monitoring and safety system

On request:

- failure mode and failure effect analyses
- risk analysis related to additional hazards (e.g. hydrogen, high pressures above 40 bar etc.)
- process simulations
- dispersant analysis. If required, the analysis shall assume discharges as a consequence of full blow-down or a fire scenario, whichever is greater.

SECTION 4 MATERIALS

1 General

Materials for pressure vessels shall comply with the requirements in DNVGL-RU-SHIP Pt.5 Ch.7 to cargo process pressure vessels.

Materials for liquified gas tanks shall comply with the requirements in DNVGL-RU-SHIP Pt.5 Ch.7.

Materials for pipes and fittings made from steel shall comply with the requirements in DNVGL-RU-SHIP Pt.2 Ch.2 Sec.5.

Pipes in plastic materials used for seawater services shall be of an approved type.

Documentation of material quality shall be submitted as given in Table 1.

Table 1 Documentation of material quality

Item	*Documentation*
Pressure vessels	See DNVGL-RU-SHIP Pt.5 Ch.7
Pipes and bodies of valves and fittings, pump housings and other pressure containing components not considered as pressure vessels, for liquefied gas[1)]	VL material certificate
Tanks for liquefied gas	See DNVGL-RU-SHIP Pt.5 Ch.7
Pipes and bodies of valves and fittings, pump housings and other pressure containing components not considered as pressure vessels, for hydrocarbon liquids and gases, except liquefied gas	W (Works material certificate)
Other piping	TR (Test report), type approval (TA) if plastic material
Flanges in systems for hydrocarbon liquids and gases, including liquified gas	W (Works material certificate)
Nuts and bolts	TR (Test report)
1) For pipes in open ended piping systems as well as pipes with nominal diameter below 25 mm, W may be used instead of VL material certificates.	

SECTION 5 COMPONENT CERTIFICATION

1 General

The following components shall be delivered with a VL product certificate:

— tanks for liquified gas (see also DNVGL-RU-SHIP Pt.5 Ch.7)
— pressure vessels (see also DNVGL-RU-SHIP Pt.5 Ch.7)
— heat exchangers
— pumps for oil or liquefied gases
— gas compressors
— rotating expanders
— thermal expansion valves
— blow down valves
— safety relief valves
— sea inlet/outlet valves
— internal combustion engines
— electrical equipment and instrumentation, see guidance note below.

Guidance note:

As per DNVGL-RU-SHIP Pt.5 Ch.7, pressure vessels containing hydrocarbon gas in liquid and/or gaseous state in normal operation shall be graded as Class I - pressure vessels, according to requirements given in DNVGL-RU-SHIP Pt.4 Ch.7 Sec.1. Other pressure vessels should follow the grading of pressure vessels definitions given in DNVGL-RU-SHIP Pt.4 Ch.7.

Electric generators, motors, assemblies and transformers should be certified according to DNVGL-RU-SHIP Pt.4 Ch.8 Sec.1 as 'equipment for important functions'. Computer based systems should be certified according to DNVGL-RU-SHIP Pt.4 Ch.9 Sec.1 as 'systems for important functions'.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

The following components shall as minimum be delivered with makers' certificate:

— valves
— sea water/fresh water pumps (provided not used for ship systems serving main functions).

SECTION 6 SYSTEM ARRANGEMENTS

1 Arrangements

The temperature of flammable gas or liquid in any vapour recovery system shall not exceed 220°C, unless means are provided to prevent auto-ignition in the event of gas or liquid leakages. This may be achieved through permanent means for cooling the high temperature surfaces or through permanent inerting of spaces containing the high temperature surfaces. Removable thermal insulation is not considered as an acceptable mean for prevention.

Where high temperature surfaces are located within permanently inerted spaces, the following applies:

- any equipment, including electrical equipment and instrumentation, located within the space shall be certified for the maximum obtainable temperature within the space in question
- the inert gas supply shall be monitored. An audible and visible alarm shall be activated at a manned control station in the event of loss of supply
- arrangements shall be provided for emergency pressure relief in the event of gas leakages within the protected space. The relief system shall have capacity taking into account the maximum achievable gas leakage
- the space shall be arranged with fixed gas detection, fixed fire detection and fire extinguishing in accordance with Sec.7 and Sec.9
- the access doors to the space shall be bolted and provided with warning signs to prevent normal access when the space is inerted
- the space shall be arranged for thorough fresh air ventilation without requiring space entry. Portable fans will be accepted.

Processes that involve the generation of hydrogen shall be specially considered with respect to the additional hazards hydrogen represents in the process system itself, hydrogen discharge to vent headers, leakages into ship systems and hydrogen leaks into enclosed spaces. A risk assessment related to hydrogen hazards shall be carried out.

Leakage points in piping systems containing liquid hydrocarbon gas, such as flanges, pumps, valves and flexible elements piping containing hydrocarbon liquids, must be evaluated with respect to leakages, spray and associated possible low temperature damages to surrounding structures.

The material of structures shall have a design temperature corresponding with the lowest temperature it may be subjected to in a probable maximum leakage scenario, including possible spray. If required and unless suitable thermal protection is provided, drip trays shall be provided. Drip trays shall be provided with leakage detection that automatically isolated the source of leakage (typically tank valves). The capacity of drip trays shall be based on a probable maximum leakage scenario. Drip trays shall be arranged for drainage of water and drain lines shall be provided with self-closing valves.

Spaces containing hydrocarbon liquid piping systems shall be designed to withstand the maximum pressure build up in a maximum probable leakage scenario.

2 Hydrocarbon piping

Piping for hydrocarbon liquids or gases shall be joined by butt welding, except for diameters less than 60 mm, where sleeve type welded joints may be accepted. The number of flange connections shall be limited to what is necessary for maintenance purposes and for connecting to tanks, pressure vessels and other components.

Sufficient flexibility in the piping system, to accommodate thermal expansion and the deflection of the hull structures, shall be built-in through offset of piping or by expansion loops. The use of bellows will normally not be permitted. Sleeve type expansion joints in low pressure liquid and vapour lines, on open deck, may be especially considered.

For systems involving very high gas pressures (above 40 barg), special requirements may apply to use of low temperature materials and protection of adjacent structures exposed to cold jets in case of leakages.

Where high pressure systems are connected directly or indirectly to cargo tanks, two barriers shall be provided to prevent overpressure of cargo tanks. One of these barriers shall be a safety relief valve with full flow capacity and with a setting not exceeding the design pressure of the cargo tanks. The safety relief shall be located in the interconnected piping system. The safety relief shall be independent of the cargo tanks' P/V-valves and P/V-breaker.

3 Gas venting system

Venting of non-condensed/non-absorbed hydrocarbon gases shall be arranged through cold vents located at a minimum distance of 10 m from intakes/openings into non-hazardous spaces and at a height of minimum B/3 or 6 m whichever is greater above decks or a raised gangway, if situated within 4 m of the gangway. The vent outlet(s) shall be fitted with a flame arrestor in accordance with IMO's MSC/Circ.677.

Discharges from pressure relief valves in the hydrocarbon gas system may be directed through the process venting system provided it can be shown that a sudden release of gas under pressure does not cause harmful effects in the recovery system. If separate discharge outlets from safety relief valves are arranged their locations shall be as for process vents. All vent lines shall have means for separation and drainage of liquid droplets, e.g. knock-out drums.

For systems involving storage of gas under very high pressures (above 40 barg), the blow-down vent system shall have capacity for emergency blow-down and shall be independent of the cargo tank venting and inert gas system.

4 Cooling liquid system

Liquids used for cooling or heating of hydrocarbon fluids shall not be returned to non-hazardous spaces unless the following conditions are met:

- cooling or heating liquid shall be led via a degassing tank located in the cargo area
- the degassing tank shall be fitted with continuous gas detection raising an alarm at a gas concentration corresponding to 20% of LEL
- if the gas concentration exceeds 60% of LEL an automatic process shut down shall be executed. The shut-down shall include automatic isolation of any cooling or heating piping system connection leading to non-hazardous spaces
- the degassing tanks shall have capacity to accumulate and ventilate out the maximum gas volume that can be generated and thus prevent gas ingress into non-hazardous systems and spaces. The system shall be considered as a safety system that shall have capacity and response time to prevent entrapped gas in accumulating in any part of a system located in a non-hazardous space after closing of process shut down valves
- degassing tank air pipe outlets shall be considered as hazardous zones and such outlets shall be provided with flame arrestors
- where steam and condensate is directly connected to hydrocarbon processing systems, the following applies:
  - the steam supply shall be provided with non-return devices and flow monitoring. Upon loss of flow, automatic process shut-down shall be executed. The shut-down shall include automatic isolation of the steam piping system connection leading to non-hazardous spaces
  - the condensate return system shall be arranged with condensate separator drum preventing gas blow by to the condensate system. The drums shall be provided with level detection and alarm. Upon low level detection, the automatic process shut-down shall be executed. In addition, degassing tanks with gas detection executing automatic process shut-down as required for cooling and heating systems shall be provided. The process shut-down shall include automatic isolation of the condensate system connection leading to non-hazardous spaces

5 Purging and inerting

Arrangements for draining, purging and inerting the hydrocarbon piping systems shall be provided.

SECTION 7 FIRE SAFETY

1 General

Where VOC installation involve high gas pressures (above 40 barg), special fire safety considerations e.g. as given in DNVGL-RU-SHIP Pt.5 Ch.8.

2 Control room

The exterior boundaries of the process control room shall be insulated to A-60 standard, if located outside the accommodation deckhouse. Additionally the exterior boundaries shall be protected by a water spray system. The capacity of the system shall correspond to a minimum quantity of 5 litres/minute/m^2 of the area to be protected.

3 Process components on open decks

The following process components shall be protected by a water spray system with the minimum capacities below:

— process pressure vessels if arrangements for remotely controlled blow-down is not provided: 5 litres/minute/m^2 exposed surface area
— pumps and compressors for oil/gas and emergency shut-down valves on open deck: 5 litres/minute/m^2 horizontally projected area.

Passive fire protection may be accepted for protection of these components in lieu of water spray if supported by a fire risk analysis. Emergency shut-down valves can be accepted with passive protection if they are of fail-safe type with internal spring return.

4 Deck tank

Deck tanks for storage of recovered and liquefied vapour shall be protected by a water spray system as specified in DNVGL-RU-SHIP Pt.5 Ch.7 Sec.11 [3.1.2].

5 Fire detection

Spaces containing hydrocarbon process installations and electric motor rooms shall be fitted with a fixed fire detection and fire alarm system. This applies also to semi-open spaces. Manual call points shall be fitted at each exit.

6 Deck fire extinguishing

The deck area, in way of process installations, shall be covered by a foam fire extinguishing system complying with the requirements for deck foam systems for oil tankers (see DNVGL-RU-SHIP Pt.5 Ch.5 Sec.7). Additional capacity and coverage may be required depending on the arrangements of the installations.

7 Fire extinction in enclosed spaces

Enclosed spaces containing hydrocarbon process installations shall be provided with a fixed fire extinguishing system in accordance with the requirements in SOLAS Ch. II-2/10.4. The capacity of a fixed pressure water spray system shall not be less than 10 litres/minute above the risk objects.

Semi-open spaces shall be protected by a water based fire extinguishing system providing an equivalent level of protection.

SECTION 8 VENTILATION

1 Process spaces

Enclosed spaces containing hydrocarbon process installations shall be provided with mechanical ventilation, with capacity sufficient for giving at least 30 air-changes per hour. The ventilation system shall be of the extraction type and shall ensure that thorough ventilation is achieved even below floor plates.

2 Electric motor room

Electric motor rooms contiguous to the boundaries of the process spaces as defined in [1], shall be provided with mechanical ventilation with a capacity of at least 30 air changes per hour.

Electric motor rooms not contiguous to the boundaries of the process spaces as defined in [1], but at a distance more than 600 mm apart and outside gas dangerous zone, shall be provided with mechanical ventilation with a capacity of at least 8 air changes per hour. The ventilation capacity shall be large enough to keep the room temperature within the ambient air temperature range specified in DNVGL-RU-SHIP Pt.4 Ch.1 Sec.3 Table 2, taking into account the heat generated by the electric motors.

The ventilation shall be of the overpressure type with inlets and outlets in gas safe zones. If the entrance to the electric motor room is via an air lock, then the arrangements shall comply with the requirements given in DNVGL-RU-SHIP Pt.5 Ch.7 Sec.3 [6].

3 Control room

If the process control room is located in the cargo area the mechanical ventilation system shall be sized to give at least 8 air changes per hour. The ventilation shall be of the overpressure type with inlets and outlets located in gas safe zones.

SECTION 9 CONTROL, SAFETY AND MONITORING SYSTEM

1 General

Centralised surveillance and control of the vapour recovery process plant shall be arranged, preferably from a location giving the possibility for visual overview of the process area. In addition to normal surveillance and control functions it shall be possible to execute the following operations from the control position:

— emergency shut down (ESD) of the process plant.
— process shut down (PSD) of the process plant.
— Release of the water spray system.
— release of the fire extinguishing system for process installation spaces. Stopping of ventilation fans and closing of dampers shall be automatically executed in a correct sequence.

Remote manual release of ESD shall also be possible from near the loading manifolds and from the navigation bridge.

Vapour recovery systems supplying VOC as fuel to gas fuelled machinery, shall comply with the requirements for control, monitoring and safety systems as required by DNVGL-RU-SHIP Pt.6 Ch.2 Sec.5. The requirements imply that the system shall be arranged for automatic isolation of gas supply to gas fuelled machinery based on the criteria given in DNVGL-RU-SHIP Pt.6 Ch.2 Sec.5.

2 Monitoring

The extent and details of alarms and automatic actions shall be determined for each installation depending of type and arrangements of the vapour recovery plant. However, Table 1 may serve as guidance.

For systems involving very high pressure gas (above 40 barg), temperature monitoring with alarm and shut-down may be required to prevent excessive low temperatures during operation.

3 Gas detection

Monitoring of relevant hydrocarbon gases shall be fitted. Detectors shall be located inside any room containing hydrocarbon processing systems such as compressor room, crude pump-room. In addition detectors shall be located at the ventilation inlet inside any associated electric motor room.

The location of gas detectors shall take into account the density of the hydrocarbons being processed. The detection equipment shall be located where gas may accumulate and as a minimum below floor plates, in way of leakage sources above floor plates and in ventilation outlets. Gas dispersal analysis or a physical smoke test shall be used to find the best arrangement.

Where VOC installation involve high gas pressures (above 40 barg), depending on extent of hazardous zones, gas detection may also be required on open deck.

4 Independence

The safety actions/shutdowns required by these rules shall be independent of the system handling the process control, alarm and monitoring. See DNVGL-RU-SHIP Pt.4 Ch.9 Sec.3 [1.1.3].

5 Fail-safe

Loss of power supply (electric, pneumatic or hydraulic) shall not cause critical conditions in the vapour recovery plant or in the ship’s systems.

Table 1 Monitoring of vapour recovery plant

Item		*Alarm*	*Automatic actions*
Pressure gas line suction side	Low Lower	x	PSD
Pressure gas line discharge side	High	x	
Pressure crude oil line suction side	Low Lower	x	PSD
Pressure crude oil line discharge side	High Higher	x	PSD
Pressure cooling medium to gas condensers	Low Low-Low	x x	PSD
Level liquid separators	High High-High Low-Low[1)]	x x x	PSD PSD
Level gas absorption vessel	High Low	x x	
Level knock out drums in gas/vent lines	High	x	
Gas concentration compressor room/pump room and electro motor room and other spaces containing hydrocarbon processing systems.		Above 10% of LEL	ESD if two detectors in alarm state, one of which is above 30% LEL
Gas concentration in heating/cooling liquid degassing tank (if fitted)		Above 20% of LEL	PSD if above 60% of LEL
Fire in compressor room/pump room and other spaces containing hydrocarbon processing systems		x	ESD
Level storage tank for liquefied gas	High High-High	x	PSD
Pressure for control air or hydraulics	High Low Low-low	x x	PSD
Loss of electric power supply to the control and or monitoring system		x	
Loss of ventilation in compressor room/pump room or electro motor room[3)]		x	
Temperature monitoring bulkhead shaft glands and bearings		x	
Liquid level vaporizers	High	x	Stop of liquid transfer and closing of isolation valves
Pressure inert gas supply to permanently inerted spaces (if fitted)[2)]	low low-low	x	PSD

Item	*Alarm*	*Automatic actions*
Note: PSD: Normal shut down of process plant in a controlled sequence. ESD: Emergency shut down of process plant, i.e. stop of oil pumps and gas compressors and closing of isolation valves between ship's cargo and/or vapour system and the vapour recovery system. Also valves on liquid and vapour lines' connection to any storage tank(s) for liquefied gas, if applicable, shall close. 1) If separators have drain to slop/cargo tanks. In order to protect against high pressure gas blow-by, PSD and alarm shall be activated in case of low-low level in liquid separators and drain valve to slop/cargo tanks in open position. 2) Oxygen level detection may also be accepted. 3) As per IEC-60092-502. Activation based on fan motor running or fan rotation monitoring device is not sufficient.		

SECTION 10 ELECTRICAL INSTALLATIONS

1 General

Electrical installations shall comply with the requirements given in DNVGL-RU-SHIP Pt.5 Ch.7 Sec.10 *Liquefied gas tankers*, when it comes to hazardous area and explosion proof equipment.

Electrical installations in general shall comply with the requirements given in DNVGL-RU-SHIP Pt.4 Ch.8 *Electrical installations*. With respect to defining the minimum generator capacity of the ship, the VOC plant may be regarded as "non important load".

If the VOC is used as a gas fuel for combustion machinery serving main functions, the importance of the VOC plant load shall be specially considered.

Where VOC installation involve high gas pressures (above 40 barg), a potential increased extent of hazardous zone classification shall be considered. This shall normally be assessed by dispersant analysis.

SECTION 11 MANUFACTURE, WORKMANSHIP, INSPECTION AND TESTING

1 General

The requirements given in DNVGL-RU-SHIP Pt.4 Ch.6 *Piping systems*, apply, with the additions given in Sec.10.

2 Non-destructive testing (NDT)

At least 10% of all welded joints in piping systems for hydrocarbon liquids or gases, except open ended vent lines, shall be subjected to NDT.

Butt welds are subject to radiographic or ultrasonic testing and fillet welds are subject to magnetic particle testing.

3 Testing

For **VCS(3)**, survey and testing shall be carried out onboard in accordance with an approved test program. The survey of the installation including testing of safety systems shall be carried out in the presence of DNV GL to the extent possible. Testing shall include verification of the systems capability to meet the maximum emission limits. Full scale operational tests and verification of system capability to meet the emission criteria may be based on onboard tests and recordings taken during offshore loading. This testing may be carried out without DNV GL presence, provided it is carried out in accordance with the approved test program and provided a report covering the result of the testing is submitted to DNV GL for approval.

For **VCS(L, X%)**, survey and testing shall be carried out onboard in accordance with an approved test program. The survey of the installation including testing of safety systems shall be carried out in the presence of DNV GL to the extent possible. Testing shall include verification of the systems capability to meet the emission reduction criteria. Full scale operational tests and verification of system capability to meet the emission criteria may be based on onboard tests and recordings taken on a laden voyage. This testing may be carried out without DNV GL presence, provided it is carried out in accordance with the approved test program and provided a report covering the result of the testing is submitted to DNV GL for approval.

APPENDIX A RULE REFERENCES

Some applicable rule references are given in Table 1.

Table 1 Rule references

Materials for piping	DNVGL-RU-SHIP Pt.4 Ch.6
Wall thickness of pipes	DNVGL-RU-SHIP Pt.4 Ch.6
Flanges and pipe couplings	DNVGL-RU-SHIP Pt.4 Ch.6
Welding and heat treatment of pipes	DNVGL-RU-SHIP Pt.4 Ch.6 Sec.9 [1.1] to DNVGL-RU-SHIP Pt.4 Ch.6 Sec.9 [1.4]
Joining of plastic pipes	DNVGL-RU-SHIP Pt.4 Ch.6
Gas dangerous zones and spaces Hazardous Zone Classification	DNVGL-RU-SHIP Pt.5 Ch.7
Arrangements, scantlings and testing of tanks for liquefied gas	DNVGL-RU-SHIP Pt.5 Ch.7 App.A
Arrangement of VOC compressor rooms	DNVGL-RU-SHIP Pt.5 Ch.7
Ventilation fans of VOC compressor rooms	DNVGL-RU-SHIP Pt.5 Ch.7 Sec.12 [1]
Pressure vessels for low temperature, material requirements	DNVGL-RU-SHIP Pt.5 Ch.7 App.A
Pressure Vessels	DNVGL-RU-SHIP Pt.4 Ch.7
Gas Fuelled Ship Installations	DNVGL-RU-SHIP Pt.6 Ch.2 Sec.5
Arrangements of crude oil pump rooms	DNVGL-RU-SHIP Pt.5 Ch.5 App.A
Refrigeration systems	DNVGL-RU-SHIP Pt.4 Ch.6 and DNVGL-RU-SHIP Pt.5 Ch.7 App.A

CHANGES – HISTORIC

November 2015 edition

This is a new document.

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