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OFFSHORE SERVICE SPECIFICATION  
DNV-OSS-103

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RULES FOR CLASSIFICATION OF  
LNG/LPG FLOATING PRODUCTION  
AND STORAGE UNITS OR  
INSTALLATIONS

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MAY 2001

*Since issued in print (May 2001), this booklet has been amended, latest in April 2007.  
See the reference to "Amendments and Corrections" on the next page.*

DET NORSKE VERITAS

# FOREWORD

DET NORSKE VERITAS (DNV) is an autonomous and independent foundation with the objectives of safeguarding life, property and the environment, at sea and onshore. DNV undertakes classification, certification, and other verification and consultancy services relating to quality of ships, offshore units and installations, and onshore industries worldwide, and carries out research in relation to these functions.

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- G) Asset Operation
- H) Marine Operations
- J) Wind Turbines

## Amendments and Corrections

This document is valid until superseded by a new revision. Minor amendments and corrections will be published in a separate document normally updated twice per year (April and October).

For a complete listing of the changes, see the "Amendments and Corrections" document located at: <http://webshop.dnv.com/global/>, under category "Offshore Codes".

The electronic web-versions of the DNV Offshore Codes will be regularly updated to include these amendments and corrections.

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## SECTION 1 INTRODUCTION

### A. General

#### A 100 DNV offshore publications

**101** This publication presents DNV's Rules for Classification of LNG or LPG Floating Production and Storage Units or Installations and shall be regarded as supplementary to DNV-OSS-102. DNV-OSS-102 is thus stating the terms and procedures for assigning and maintaining classification, technical requirements for main class (**1A1** and **OI**), including listing of the applicable technical references to be applied for classification.

### B. References

#### B 100 Normative references

**101** The standards given in Table B1, Table B2 and Table B3 include provisions, which through reference in this text constitute provisions for this standard.

#### B 200 Offshore service specifications and rules

**201** The offshore service specifications and rules given in Table B1 are referred to in this standard.

<i>Reference</i>	<i>Title</i>
DNV-OSS-102	Rules for Classification of Floating Production, Storage and Loading Units
Rules for Classification of Ships Pt.5 Ch.5	Liquefied Gas Carriers

#### B 300 Offshore standards

**301** The offshore standards given in Table B2 are referred to in this standard.

<i>Reference</i>	<i>Title</i>
DNV-OS-A101	Safety Principles and Arrangement
DNV-OS-B101	Metallic Materials
DNV-OS-C101	Design of Offshore Steel Structures, General (LRFD method)
DNV-OS-C102	Structural Design of Offshore Ships
DNV-OS-C103	Structural Design of Column Stabilised Units (LRFD method)

<i>Reference</i>	<i>Title</i>
DNV-OS-C104	Structural Design of Self Elevating Units (LRFD method)
DNV-OS-C105	Structural Design of TLPs (LRFD method)
DNV-OS-C106	Structural Design of Deep Draught Floating Units
DNV-OS-C301	Stability and Watertight Integrity
DNV-OS-C401	Fabrication and Testing of Offshore Structures
DNV-OS-E201	Hydrocarbon Production Plant
DNV-OS-E301	Position Mooring
DNV-OS-E401	Helicopter Decks
DNV-OS-F201	Dynamic Risers

#### B 400 Guidelines and other references

**401** The Guidelines and other references given in Table B3 are referred to in this standard.

<i>Reference</i>	<i>Title</i>
Guideline No. 17	Plan Approval Documentation Types – Definitions
ICG Code	The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, as amended

### C. Informative References

#### C 100 Other references

**101** The documents listed in Table C1 include acceptable methods for fulfilling the requirements in the standard and may be used as a source of supplementary information.

<i>Reference</i>	<i>Title</i>
ISO 5817	Arc-welded joints in steel - Guidance on quality levels for imperfections
ISO 10042	Arc-welded joints in aluminium and its weldable alloys - Guidance on quality levels for imperfections
DNV Classification Note 30.7	Fatigue Assessment of Ship Structures

## SECTION 2

# SUPPLEMENTARY REQUIREMENTS FOR SERVICE NOTATION PRODUCTION UNIT OR PRODUCTION INSTALLATION

### A. General

#### A 100 Introduction

**101** This section identifies design and construction requirements for assignment of service notation **LNG Production Unit** or **LPG Production Unit** or **LNG Production Installation** or **LPG Production Installation**.

**102** The requirements in this section are supplementary to those for main class **1A1** as stated in DNV-OSS-102 Ch.2 Sec.1 for notation **Production Unit** and **OI** in DNV-OSS-102 Ch.2 Sec.2 for notation **Production Installation**. The requirements in this section are based on the unit or installation being a combined oil and gas producing unit or installation. Hence, there are requirements that are not applicable if the unit or installation is only producing gas.

**103** Although the requirements in this section are partly based on the Rules for Classification of Ships Pt.5 Ch.5, assignment of this service notation does not fulfil all requirements of the IGC Code.

**104** The term *shore connection* as used in the Rules for Classification of Ships Pt.5 Ch.5 should be read as a connection to the LNG or LPG shuttle tanker.

#### A 200 Documentation requirements

**201** Documentation requirements shall be in accordance with the NPS DocReq (DNV Nauticus Production System for documentation requirements) and Guideline No.17.

**202** Documentation required for abbreviations **1A1** and PSU, alternatively **OI** and PSU shall be submitted.

**203** In addition, relevant documentation requirements as outlined in referenced parts of the Rules for Classification of Ships Pt.5 Ch.5 shall be submitted.

### B. Safety Principles and Arrangement

#### B 100 General

**101** In addition to the informative references given in DNV-OS-A101 Sec.1 C101, the IGC Code should be added.

**102** *Additional to DNV-OS-A101 Sec.2 C103*

A LNG or LPG oil and gas producing and storage unit or installation is regarded to be complex and non-standard in this respect, thus requiring a more comprehensive safety assessment as outlined in DNV-OS-A101 Appendix C. In addition to typical hazards listed in DNV-OS-A101 Appendix C, A500, special emphasis shall be made to hazards such as:

- release of cryogenic liquids
- offloading concepts and operation
- spread of fire that may threaten tank integrity.

Solutions for quick disconnection of mooring lines between the shuttle tanker and the oil and gas producing and storage unit or installation, where these are moored alongside by conventional means, shall be found if the formal safety assessment assumes or recommends such actions as a means of reducing the consequences.

**103** Service notation **LNG Production Unit** or **LPG Production Unit** or **LNG Production Installation** or **LPG Production Installation** specifies additional requirements for:

- arrangement
- area classification
- shutdown
- escape, evacuation and communication.

#### B 200 Arrangement

**201** Production units or installations shall comply with DNV-OS-A101 Sec.7, and the following:

1) *Additional to DNV-OS-A101 Sec.7 A102:*

See also the Rules for Classification of Ships Pt.5 Ch.5:

- Sec.3 B: location and separation of spaces
- Sec.3 C200: gas dangerous spaces and cargo tanks
- Sec.3 C400: cofferdams and pipe tunnels
- Sec.3 D: guard-rails and bulwarks
- Sec.3 G: anodes, washing machines and other fittings in tanks and cofferdams
- Sec.4: arrangements and environmental control in hold spaces.

2) *Additional to DNV-OS-A101 Sec.7 B202:*

Drainage system shall also be suitable for liquefied gas spills. Materials of the process deck and drainage system, including coamings and piping, shall be suitable for the low temperatures. Process deck with drainage shall be designed to prevent spillage on tank deck. These requirements are also applicable for the offloading area where spills may be anticipated. Where offloading is performed with a shuttle tanker moored alongside, a water spray system for heating of the hull exposed to leakage shall be provided.

The need for heating of the hull at outlets from open deck drainage led over board shall be considered.

3) *Additional to DNV-OS-A101 Sec.7 B803:*

For concepts with shuttle tankers moored to the **LNG Production Unit** or **LPG Production Unit** or **LNG Production Installation** or **LPG Production Installation**, special consideration shall be made, taking the additional effect of the shuttle tanker into account (including the mooring system between the two vessels).

4) *Additional to DNV-OS-A101 Sec.7 C206:*

The following apply for **LNG Production Unit** and **LPG Production Unit** and **LNG Production Installation** and **LPG Production Installation**:

- cargo tank pressure relief valve exhaust is the source of a spherical hazardous zone 1 with a radius of 9 m.

#### B 300 Area classification

**301** **LNG Production Unit** and **LPG Production Unit** and **LNG Production Installation** and **LPG Production Installation** shall comply with DNV-OS-A101 Sec.4 and Sec.7.

#### B 400 Emergency shutdown

**401** **LNG Production Unit** and **LPG Production Unit** and **LNG Production Installation** and **LPG Production Installation** shall comply with DNV-OS-A101, Sec.5 and Sec.7.

#### B 500 Escape, evacuation and communication

**501** **LNG Production Unit** and **LPG Production Unit** and **LNG Production Installation** and **LPG Production**

**Installation** shall comply with DNV-OS-A101, Sec.7.

## C. Structural Design

### C 100 General

**101** Service notation **LNG Production Unit** or **LPG Production Unit** or **LNG Production Installation** or **LPG Production Installation** specifies additional requirements for:

- process area structural modules
- process area foundations
- turret or submerged turret structures.

**102** The structural strength shall be as required for the main class taking into account necessary strengthening of supporting structures for equipment applied in and forces introduced by the production facilities and operation.

### C 200 Supplementary technical requirements

**201** The items listed in 101 shall comply with the relevant sections of DNV-OS-C101 and:

- DNV-OS-C102 for ship-shaped units or installations
- DNV-OS-C103 for column-stabilised units or installations
- DNV-OS-C104 for self-elevating units or installations
- DNV-OS-C105 for tension leg units or installations
- DNV-OS-C106 for deep draught units or installations.

**202** Hull strength and the support structure for independent cargo tanks are to comply with the requirements in DNV-OS-C102. Strength of independent cargo tanks shall comply with the requirements in the Rules for Classification of Ships Pt.5 Ch.5 Sec.5. Accelerations acting on tanks shall be determined by direct calculations based on location specific environmental data with a return period of 100 years. DNV-OS-C101 replaces all references to the Rules for Classification of Ships Pt.3 Ch.1.

**203** For definition of tank types reference shall be made to the Rules for Classification of Ships Pt.5 Ch.5 Sec.1 D.

**204** The containment systems shall be designed to withstand the loads referred to in 202 at all loading conditions.

**205** Material selection shall comply with the requirements in DNV-OS-C101. Cargo tanks and supporting structure subject to reduced temperature due to the cargo shall comply with the requirements in the Rules for Classification of Ships Pt.5 Ch.5 Sec.2. DNV-OS-C101 replaces all references to the Rules for Classification of Ships Pt.3 Ch.1 Sec.2.

**206** Where the Rules for Classification of Ships Pt.5 Ch.5 Sec.5 refer to IIW mark 4 (blue) as acceptance criteria for radiographs, ISO 5817 class B for steel and ISO 10042 class B for aluminium are regarded as equivalent standards.

## D. Marine and Machinery or Utility Systems

### D 100 General

**101** Service notation **LNG Production Unit** or **LPG Production Unit** or **LNG Production Installation** or **LPG Production Installation** specifies additional requirements for:

- piping arrangements
- ventilation in hazardous areas
- turret machinery
- use of gas and crude oil for auxiliary boilers and turbines.

### D 200 Supplementary technical requirements

**201** The items listed in 101 shall comply with the relevant sections of DNV-OS-D101.

## E. Fire Protection

### E 100 General

**101** Service notation **LNG Production Unit** and **LPG Production Unit** and **LNG Production Installation** and **LPG Production Installation** specifies additional requirements for:

- passive fire protection
- fire water systems
- active fire protection of specific areas
- fire detection and alarm systems
- gas detection.

### E 200 Supplementary technical requirements

**201** Production units or installations shall comply with DNV-OS-D301, Ch.2 Sec.7 and the following:

1) *Additional to DNV-OS-D301 Ch.2 Sec.7 B300:*

B302 shall in addition read:

Bulkheads between cargo pump and compressor rooms, including their trunks, and machinery spaces shall be class A, and shall have no penetrations that are less than class A-0 or equivalent in all respects, other than the cargo pump and compressor shaft glands and similar glanded penetrations, see also Table 2-1 and Table 2-2.

2) *Additional to DNV-OS-D301 Ch.2 Sec.7 F:*

*Fire fighting in LNG or LPG loading or offloading area and STP room*

The offloading area shall have the following fire fighting equipment:

- water jet and dry powder equipment according to *DNV-OS-D301 Ch.2 Sec.7 F300*, covering the loading and offloading areas. Number, location and type of monitors shall be optimised with regard to fire-fighting efficiency
- water jet covering the mooring area
- water-based sprinkler system according to *DNV-OS-D301 Ch.2 Sec.7 F200*, covering the mooring chain and fairlead, if fitted
- water-based sprinkler system for the bow loading
- connector room
- water-based sprinkler system covering any other cargo valves and equipment with a leakage potential
- fixed fire-extinguishing system in the submerged turret loading or submerged turret production compartment shall be according to the requirements in cargo compressor and pump rooms in *DNV-OS-D301 Ch.2 Sec.7 F400*, or a water based sprinkler system according to *DNV-OS-D301 Ch.2 Sec.7 F200*.

3) *Additional to DNV-OS-D301 Ch.2 Sec.7 G:*

G104 shall in addition read:

Area of fire detection shall also include gas processing areas and all cargo tank areas. Automatic shutdown shall also include gas processing facilities.

4) *Additional to DNV-OS-D301 Ch.2 Sec.7 H:*

H104 shall in addition read:

Area of gas detection shall also include gas processing areas and all cargo tank areas. Automatic shutdown shall also include gas processing facilities.

**202** *Additional to DNV-OS-D301 Ch.2 Sec.5 B, as referenced in main class requirements:*

Additional requirements for protective and safety equipment in the Rules for Classification of Ships Pt.5 Ch.5 Sec.19 A and requirement for fireman's outfit according to Pt.5 Ch.5 Sec.11 B200 shall apply.

## F. Cargo Systems and Equipment

### F 100 General

**101** Service notation **LNG Production Unit** or **LPG Production Unit** or **LNG Production Installation** or **LPG Production Installation** specifies additional requirements for cargo systems and equipment.

### F 200 Supplementary technical requirements

**201** The requirements given by the Rules for Classification of Ships Pt.5 Ch.5, shall be complied with as referenced below:

- piping systems in cargo area (Pt.5 Ch.5 Sec.6 A, B and C)
- cargo pressure or temperature control (Pt.5 Ch.5 Sec.7 A)
- cargo heating arrangements (Pt.5 Ch.5 Sec.7 B)
- insulation for tanks, hold spaces and piping (Pt.5 Ch.5 Sec.7 C)
- marking of tanks, pipes and valves (Pt.5 Ch.5 Sec.8)
- gas-freeing and venting of cargo tanks and piping systems (Pt.5 Ch.5 Sec.9)
- tests after installation onboard (Pt.5 Ch.5 Sec.14, see below)
- gas operated propulsion machinery (Pt.5 Ch.5 Sec.16)
- filling limits for cargo tanks (Pt.5 Ch.5 Sec.17)
- inert gas plants (Pt.5 Ch.5 Sec.18)

Reference to Pt.5 Ch.5 Sec.14 includes only A104 and A106. A106 shall read: The hull shall be inspected for cold spots.

**202** Where the Rules for Classification for Ships refer IIW mark 4 (blue) as acceptance criteria for radiographs, ISO 5817 class B is regarded as equivalent standard.

## G. Instrumentation and Automation

### G 100 General

**101** Service notation **LNG Production Unit** or **LPG Production Unit** or **LNG Production Installation** or **LPG Production Installation** specifies additional requirements for instrumentation and automation.

### G 200 Supplementary technical requirements

**201** The requirements given by the Rules for Classification of Ships Pt.5 Ch.5 Sec.13 shall be complied with. The following is supplemental to the requirements therein:

B201: The alarm shall be so that the operator will have sufficient time to stop the flow without exceeding the maximum permissible filling level.

B202: The automatic shut off valve shall be operated as part of the shutdown logic for the emergency shutdown system or process shutdown system integrating the process systems.

B300: Alarm levels for gas detection are governed by DNV-OS-D301 Sec.5 D104; at levels of 25% and 60% of lower explosion limit.

## SECTION 3

# SUPPLEMENTARY REQUIREMENTS FOR SERVICE NOTATION STORAGE UNIT OR STORAGE INSTALLATION

### A. General

#### A 100 Introduction

**101** This section identifies design and construction requirements for assignment of service notation **LNG Storage Unit** or **LPG Storage Unit** or **LNG Storage Installation** or **LPG Storage Installation**.

**102** The requirements in this section are supplementary to those for main class **1A1** as stated in DNV-OSS-102 Ch.2 Sec.1 for notation **Storage Unit** and **OI** in DNV-OSS-102 Ch.2 Sec.2 for notation **Storage Installation**. The requirements in this section are based on the unit or installation being a combined oil and liquefied gas storage unit or installation. Hence, there are requirements that are not applicable if the unit or installation is only storing liquefied gas.

**103** Although the requirements in this section are partly based on the Rules for Classification of Ships Pt.5 Ch.5, assignment of this service notation does not fulfil all requirements of the IGC Code.

**104** The term *shore connection* as used in the Rules for Classification of Ships Pt.5 Ch.5 should be read as a connection to the LNG or LPG shuttle tanker.

**105** Storage units or installation also intended for transportation of cargo shall comply with the Rules for Classification of Ships Pt.5 Ch.5.

#### A 200 Documentation requirements

**201** Documentation requirements shall be in accordance with the NPS DocReq (DNV Nauticus Production System for documentation requirements) and Guideline No.17.

**202** Documentation required for abbreviations **1A1** and PSU, alternatively **OI** and PSU shall be submitted.

**203** In addition, relevant documentation requirements as outlined in referenced parts of the Rules for Classification of Ships Pt.5 Ch.5 shall be submitted.

### B. Safety Principles and Arrangement

#### B 100 General

**101** In addition to the informative references given in DNV-OS-A101 Sec.1 C101, the IGC Code should be added.

**102** Service notation **LNG Storage Unit** or **LPG Storage Unit** or **LNG Storage Installation** or **LPG Storage Installation** specifies additional requirements for:

- arrangement
- area classification
- shutdown
- escape, evacuation and communication.

#### B 200 Arrangement

**201** **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** shall comply with DNV-OS-A101, Sec.7, applicable parts, and the following:

- 1) *Additional to DNV-OS-A101 Sec.7 A102:*  
See also the Rules for Classification of Ships, Pt.5 Ch.5.  
Sec.3 B: location and separation of spaces

- Sec.3 C200: gas dangerous spaces and cargo tanks
- Sec.3 C400: cofferdams and pipe tunnels
- Sec.3 D: guard-rails and bulwarks
- Sec.3 G: anodes, washing machines and other fittings in tanks and cofferdams
- Sec.4: arrangements and environmental control in hold spaces.

- 2) *Additional to DNV-OS-A101 Sec.7 B202:*

Drainage system shall also be suitable for liquefied gas spills. Materials of the drainage system (including coamings and piping) shall be suitable for the low temperatures. The requirements are also applicable for the offloading area where spills may be anticipated. Where offloading is performed with a shuttle tanker moored alongside, a water spray system for heating of the hull exposed to leakage shall be provided.

The need for heating of the hull at outlets from open deck drainage led over board, shall be considered.

- 3) *Additional to DNV-OS-A101 Sec.7 B803:*

For concepts with shuttle tankers moored to the **LNG Storage Unit** or **LPG Storage Unit** or **LNG Storage Installation** or **LPG Storage Installation**, special considerations shall be made, taking the additional effect of the shuttle tanker into account (including the mooring system between the two vessels).

- 4) *Additional to DNV-OS-A101 Sec.7 C206:*

The following apply for **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation**:

- cargo tank pressure relief valve exhaust is the source of a spherical hazardous zone 1 with a radius of 9 m.

#### B 300 Area classification

**301** **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** shall comply with DNV-OS-A101, Sec.4.

#### B 400 Emergency shutdown

**401** **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** shall comply with DNV-OS-A101, Sec.5 and Sec.7.

#### B 500 Escape, evacuation and communication

**501** **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** shall comply with DNV-OS-A101, Sec.7.

### C. Structural Design

#### C 100 Application

**101** Service notations **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** specifies additional requirements for:

- turret or submerged turret structures, as applicable.

#### C 200 Supplementary technical requirements

**201** The items listed in 101 shall comply with the relevant sections of DNV-OS-C101 and:

— DNV-OS-C102 for ship-shaped units.

**202** Hull strength and the support structure for independent cargo tanks shall comply with the requirements in DNV-OS-C102. Strength of independent cargo tanks shall comply with the requirements in the Rules for Classification of Ships Pt.5 Ch.5 Sec.5. Accelerations acting on tanks shall be determined by direct calculations based on location specific environmental data with a return period of 100 years. DNV-OS-C101 replaces all references to the Rules for Classification of Ships Pt.3 Ch.1.

**203** For definition of tank types, see the Rules for Classification of Ships Pt.5 Ch.5 Sec.1 D.

**204** The containment systems shall be designed to withstand the loads referred to in 202 at all loading conditions.

**205** Material selection shall comply with the requirements in DNV-OS-C101. Cargo tanks and supporting structure subject to reduced temperature due to the cargo, shall comply with the requirements in the Rules for Classification of Ships Pt.5 Ch.5 Sec.2. DNV-OS-C101 replaces all references to the Rules for Classification of Ships Pt.3 Ch.1 Sec.2.

**206** Where the Rules for Classification of Ships Pt.5 Ch.5 Sec.5 refer to IIW mark 4 (blue) as acceptance criteria for radiographs, ISO 5817 class B for steel and ISO 10042 class B for aluminium are regarded as equivalent standards.

## D. Marine and Machinery or Utility Systems and Equipment

### D 100 General

**101** Service notations **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** specifies additional requirements for:

- liquid cargo transfer and stripping
- liquid cargo storing, segregation and treatment
- venting, inerting, gas freeing and vapour emission control
- oil discharge control
- crude oil washing system
- ventilation in hazardous areas
- turret machinery.

### D 200 Supplementary technical requirements

**201** The items listed in 101 shall comply with the relevant sections of DNV-OS-D101.

## E. Fire Protection

### E 100 General

**101** Service notations **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** specifies additional requirements for:

- passive fire protection
- fire water systems
- active fire protection of specific areas
- fire detection and alarm systems
- gas detection.

### E 200 Supplementary technical requirements

**201** **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** shall comply with DNV-OS-D301, Ch.2 Sec.7 and the following:

- 1) *Additional to DNV-OS-D301 Ch.2 Sec.7 B300:*  
B302 shall in addition read:

Bulkheads between cargo pump and compressor rooms, including their trunks, and machinery spaces shall be class A, and shall have no penetrations that are less than class A-0 or equivalent in all respects, other than the cargo pump and compressor shaft glands and similar glanded penetrations, see also Table 2-1 and Table 2-2.

- 2) *Additional to DNV-OS-D301 Ch.2 Sec.7 F:*  
*Fire fighting in LNG or LPG loading and offloading area and STP room*

The offloading area shall have the following fire fighting equipment:

- water jet and dry powder equipment according to F300, covering the loading, offloading and mooring areas. Number, location and type of monitors shall be optimised with regard to fire-fighting efficiency
- water-based sprinkler system according to F200, covering the mooring chain and fairlead, if fitted
- water-based sprinkler system for the bow loading connector room
- water-based sprinkler system covering any other cargo valves and equipment with a leakage potential
- fixed fire-extinguishing system in the submerged turret loading or submerged turret production compartment shall be according to the requirements in cargo compressor and pump rooms, F400, or a water based sprinkler system according to F200.

- 3) *Additional to DNV-OS-D301 Ch.2 Sec.7 G:*  
G104: Area of fire detection shall also include all cargo tank areas.

- 4) *Additional to DNV-OS-D301 Ch.2 Sec.7 H:*  
H104: Area of gas detection shall also include all cargo tank areas.

**202** Additional to DNV-OS-D301 Ch.2 Sec.5 B, as referenced in main class requirements:

Additional requirements for protective and safety equipment in the Rules for Classification of Ships Pt.5 Ch.5 Sec.19 A and requirement for fireman's outfit according to Pt.5 Ch.5 Sec.11 B200 shall apply.

## F. Liquefied Gas Storage

### F 100 General

**101** Service notations **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** specifies additional requirements for cargo systems and equipment.

### F 200 Supplementary technical requirements

**201** The requirements given by the Rules for Classification of Ships Pt.5 Ch.5 shall be complied with as referenced below:

- piping systems in cargo area (Pt.5 Ch.5 Sec.6 A, B, C)
- cargo pressure and temperature control (Pt.5 Ch.5 Sec.7 A)
- cargo heating arrangements (Pt.5 Ch.5 Sec.7 B)
- insulation for tanks, hold spaces and piping (Pt.5 Ch.5 Sec.7 C)
- marking of tanks, pipes and valves (Pt.5 Ch.5 Sec.8)
- gas-freeing and venting of cargo tanks and piping systems (Pt.5 Ch.5 Sec.9)
- tests after installation (Pt.5 Ch.5 Sec.14, see below)
- gas operated propulsion machinery (Pt.5 Ch.5 Sec.16)
- filling limits for cargo tanks (Pt.5 Ch.5 Sec.17)
- inert gas plants (Pt.5 Ch.5 Sec.18).

Reference to Pt.5 Ch.5 Sec.14 includes only A104 and A106.

A106 shall read: The hull shall be inspected for cold spots.

**202** Where the Rules for Classification for Ships refer IIW mark 4 (blue) as acceptance criteria for radiographs, ISO 5817 class B is regarded as equivalent standard.

## **G. Instrumentation and Automation**

### **G 100 General**

**101** Service notations **LNG Storage Unit** and **LPG Storage Unit** and **LNG Storage Installation** and **LPG Storage Installation** specify additional requirements for instrumentation and automation.

### **G 200 Supplementary technical requirements**

**201** The requirements given by the Rules for Classification of Ships Pt.5 Ch.5 Sec.13 shall be complied with. The following is supplemental to the requirements therein:

B201: The alarm shall be so that the operator will have sufficient time to stop the flow without exceeding the maximum permissible filling level.

B202: The automatic shut off valve shall be operated as part of the shutdown logic for the emergency shutdown or process shutdown system integrating the process systems.

B300: Alarm levels for gas detection are governed by DNV-OS-D301 Sec.5 D104; at levels of 25% and 60% of lower explosion limit.

## SECTION 4

# DESIGN AND CONSTRUCTION REQUIREMENTS FOR SYSTEM AND SPECIAL FACILITY NOTATION PROD(LNG) OR PROD(LPG)

### A. Introduction

#### A 100 General

**101** This section identifies design and construction requirements for assignment of additional class notation **PROD(LNG)** or **PROD(LPG)** relating to installations with hydrocarbon production facility including gas liquefaction plant. Other additional class notations relating to system, equipment and special facility installations, are covered in DNV-OSS-102 Ch.2 Sec.5.

#### A 200 Technical reference documents

**201** Technical requirements are given by reference to selected:

- DNV offshore standards
- DNV recommended practices
- other DNV rules and standards
- internationally recognised codes and standards.

**202** The technical reference documents that shall be applied are given in B.

#### A 300 General assumptions

**301** DNV may accept alternative solutions found to represent an overall safety level equivalent to that stated in the requirements of this document or referred standards.

**302** The requirements stated in this section for the additional class notation shall be regarded as supplementary to those given for assignment of main class and relevant service notations.

#### A 400 Documentation

**401** Documentation requirements shall be in accordance with the NPS DocReq (DNV Nauticus Production System for documentation requirements) and Guideline No.17.

**402** Documentation required for abbreviation PROD shall be submitted.

**403** In addition, relevant documentation requirements as outlined in referenced parts of the Rules for Classification of Ships Pt.5 Ch.5 shall be submitted.

### B. Hydrocarbon Production Plant including Liquefaction Plant

#### B 100 General

**101** Units or installations fitted with offshore hydrocarbon production facilities and liquefaction plants, in compliance with DNV requirements, may be assigned class notation

#### PROD(LNG) or PROD(LPG).

#### B 200 Technical requirements

**201** The requirements for production and liquefaction plants are stated in DNV-OS-E201 and the following:

- 1) *Additional to DNV-OS-E201 Ch.1 Sec.1 A400:*  
A401: With the additions listed below, the standard also covers LNG or LPG offloading system.  
A402: The boundaries are also defined by the:
  - shutdown valve at cargo outlet from liquefaction plant to cargo storage.
- 2) *Additional to DNV-OS-E201 Ch.2 Sec.1 B100:*  
B109: Any constituents of the feed gas flowing to a liquefaction plant, which may become solid at the low temperatures encountered in the process, shall be removed to the extent that the remaining amounts of such constituents will either stay in solution or be of such concentrations as to create no significant problems, fouling or plugging.
- 3) *Additional to DNV-OS-E201 Ch.2 Sec.2 H:*  
See also requirements in Sec.2 B200.
- 4) *Additional to DNV-OS-E201 Ch.2 Sec.3 D:*  
D102: The gas disposal system shall be separated such that hydrate and ice formation is eliminated. Adequate separation shall be obtained for cold gas and liquids from wet gas.  
D118: Regarding API RP 521 guideline regarding rate of depressurisation, further reference is given to C103 of DNV-OS-E201 Sec.4.
- 5) *Additional to DNV-OS-E201 Ch.2 Sec.4 D:*  
Section D is also applicable for LNG or LPG cargo offloading systems  
For special requirements for LNG or LPG cargo piping systems see the Rules for Classification of Ships Pt.5 Ch.5 Sec.6. Any reference to specific location of loading or unloading areas such as bow or stern shall be read as general requirements applicable to all areas of loading or offloading.
- 6) *Additional to DNV-OS-E201 Ch.2 Sec.6 B:*  
B107: Flanges shall be avoided as far as possible in all low temperature piping. Where flanges are unavoidable, due consideration shall be given to the effects of thermal contraction and expansion.
- 7) *Additional to DNV-OS-E201 Ch.2 Sec.7:*  
B502: Pumps used for transfer of liquids at temperatures below  $-55^{\circ}\text{C}$ , shall be provided with suitable means for pre-cooling to reduce the effect of thermal shock.

## APPENDIX A SPECIAL CONSIDERATIONS FOR CONVERSIONS

### A. Basic principles

#### A 100 Introduction

**101** This appendix has been prepared to make available DNV's approach for an efficient transfer of existing tankers to offshore production and storage units or installations.

#### A 200 Assumptions

**201** DNV assumes that the tanker being proposed for conversion:

- holds a valid class certificate from a recognised classification society
- has been assessed and considered suitable for the intended new duty and service life at a specified location.

#### A 300 Main principles

**301** All new systems shall comply with the latest DNV rules or standards or recognised international standards. Modified systems will normally be accepted based on rules or standards applicable at the time of construction. Alternative solutions will be considered based on sound engineering principles.

**302** Standard and 'field proven' equipment may be accepted without being subjected to re-certification, when equipment certificate (e.g. from a recognised classification society) or other supporting documentation provides evidence of suitability for intended use.

**303** Deviations from requirements applicable to unrestricted world-wide operation will be accommodated, by evaluating fitness for purpose at the specific location. The criteria and limitations for the unit or installation, systems or components will be stated in the "Appendix to the classification certificate".

**304** Approval schemes with terms of reference other than DNV rules or standards will be allowed for specific systems, when such references are found to give an acceptable safety level equivalent to the rules or standards.

**305** Renewal surveys on location, avoiding dry-docking, will be accommodated to the extent feasible.

### B. Class Notations

#### B 100 Conversions

**101** Class notations applicable to conversions will be as given for production and storage units in DNV-OSS-102, Ch.1 Sec.3, and DNV-OSS-103.

### C. Technical Guidance for Classification

#### C 100 General

**101** All new or modified structure, systems and components shall comply with the current class rules in force at the time of signing the classification contract.

**102** All other structures, systems and components will in principle be accepted based on rules applicable at the time of construction (when the tanker was first classed), if suitable for the intended purpose.

#### C 200 Hull and topside structures

**201** The following approach should be taken to evaluate the suitability of the hull for the intended operation:

- a) Determine the condition of the tanker with respect to corrosion and possible reduced scantlings
- b) Identify the static loads acting on the unit as a consequence of its new function:
  - total topside loads and load distribution (for longitudinal strength).
- c) Identify the environmental loads by applying **1A1 Tanker for Liquefied Gas** rules for loads and motions. Alternatively, if less strict values than above shall be applied, determine hydrodynamic wave loads and motions and accelerations for the relevant location and during transit.
- d) Assess hull girder longitudinal strength (buckling and yield) exposed to new static and dynamic loads based on the actual scantlings of the ship, if less strict values than **1A1 Tanker for Liquefied Gas** shall be applied.

**Guidance note:**  
In both cases, the NAUTICUS Hull software is an efficient tool for such assessments.

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- e) Assess local strength of
  - supporting structure for heavy topside loads
  - structures in way of mooring
  - turret structure and interface with the hull as applicable.
- f) Determine remaining fatigue life for critical structural details, accounting for the former load history.
- g) Propose inspection programme based on required fatigue life and corrosion margins, including safety factors and findings during earlier inspections.
- h) The site-specific environmental data will be included in the "Appendix to the classification certificate", with reference to source.

#### C 300 Hull condition

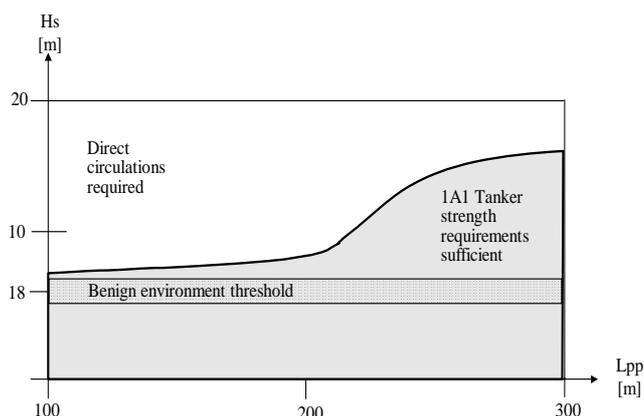
**301** It is envisaged that thickness measurements are available from the evaluation done by or on behalf of the owner in preparation for the conversion. This information together with the renewal survey carried out onboard will decide the extent of possible steel renewal to:

- bring the hull back to the basic scantlings as applicable for a tanker,  
or alternatively
- accept reduced scantlings for a specific location.

#### C 400 Hull strength in benign environment

**401** A new set of still-water load conditions needs to be defined in order to account for the new function of the unit, including global and local loads mentioned above. An existing tanker would comply with the main **1A1** class requirements, which imply that the hull girder longitudinal strength is based on the 20 years North Atlantic environmental loads ( $10^{-8}$  probability level of exceedance).

**402** If the actual site-specific environmental loading is less severe than the **1A1 Tanker for Liquefied Gas** requirements for longitudinal strength, the hull strength may be assessed according to specific acceptance criteria for benign environment (see DNV-OS-C102).



**Figure 1**  
**Typical longitudinal strength margins**

**403** This implies that the global strength may be based on direct calculations of wave bending moments and the actual scantlings of the hull. Accelerations used for the design of top-side structure and connection to the hull may be determined from these direct calculations, as an alternative to the normally more conservative **1A1 Tanker for Liquefied Gas** requirements.

### C 500 Fatigue assessment

**501** The fatigue capacity for conversions will be considered on a case-by-case basis, and is a function of the following parameters:

- results from survey and assessment of critical details
- service history of the vessel and estimated remaining fatigue life
- duration of the intended stay on a specific location and environmental conditions.

#### Guidance note:

A simplified method is described in Classification Note 30.7 which is regarded as an efficient way to establish the remaining fatigue life, and the required safety against fatigue damage. The same Classification Note also includes guidance on full stochastic fatigue analysis if this proves to be necessary. The NAUTICUS suite of software can be used to perform the calculations.

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### C 600 Topside support structure

**601** The process deck structure should be designed to applicable class rules or recognised structural codes or standards. Due consideration shall be given to the flexibility of the top-side support structure to the main hull to take care of the movement from the global bending of the unit. Existing hull structure providing support for the process plant footprints shall be checked against the Rules for Classification of Ships.

### C 700 Mooring

**701** With few exceptions, the usual station-keeping concepts are spread mooring for relatively shallow to intermediate water depths, and single-point mooring for deeper waters.

**702** There are basically two approaches for certification of the mooring system design:

- in accordance with class rules; or alternatively
- in accordance with recognised international standards (e.g. API RP 2SK).

### C 800 Marine systems and equipment

**801** The marine system piping and equipment are categorised in three groups based on the scope of the conversion work:

a) *Not subjected to any alteration, or any effect from the modification of the related systems*

These systems or equipment will be accepted based on requirements for renewal survey.

b) *Subjected to alteration and modifications*

These systems will be accepted as long as the modification of the equipment or system is carried out in accordance with rules, or recognised international standards. Modification to systems and components that are identified as safety critical shall be subject to approval. The modified system shall also undergo satisfactory pressure or function testing as required by the Rules for Classification of Ships, Pt.7 Ch.2 Sec.2, as applicable for renewal survey.

c) *New systems and equipment*

New systems and equipment that are covered by the class scope will be subject to approval based on class rules and or international standards and shall undergo satisfactory pressure or function testing as applicable based on the Rules for Classification of Ships, Pt.4 and Pt.7, for acceptance.

### C 900 Electrical and instrumentation

**901** Typical consequences of conversions will be increased power demand and hazardous zone alterations. This requires incorporation of new elements to the existing systems, and obtaining unambiguous area classification with matching equipment requirements. Integration of instrumentation for marine applications with new process and offloading functions needs to be implemented based on a consistent approach. Class requirements are based IEC standards (61892 - series). In case of incorporating of US based equipment, the hazardous area definitions will need specific attention with particular focus on Div 1 and fulfilment of Zone 0 and 1 requirements. DNV accept electrical equipment for hazardous areas provided type test certificates issued by a recognised test laboratory or institution support these. This also applies to US based UL or FM listed electrical equipment upon evaluation of premises for use and scope of testing.

### C 1000 Safety systems and arrangement

**1001** Safety systems will be subject to approval irrespective of the class scope chosen. The focus will mainly be on systems that have global impact on the safety of the vessel, and the effect from safety and control systems beyond the individual process skid or module.

**1002** The safety systems include the following:

- hazardous area classification
- ignition prevention (review of 'ex' equipment suitable for hazardous area)
- fire and gas detection system
- fixed fire fighting system
- emergency shutdown system.

**1003** Interface between safety and marine systems will be evaluated to ensure that addition of the hydrocarbon process plant has not compromised the safety and functionality of the marine systems.

**1004** The arrangement and lay-out of the processing plant should be considered in view of fire and explosion hazards, depending on size and complexity of the plant, as well as location in relation to accommodation, escape, shelter and evacuation facilities. Protection of equipment from operation of the plant should be considered, e.g. cranes and lay down areas to be in locations avoiding lifting operations over pressurised equipment.

**1005** Due regard should be given to the already built-in safety features required to fulfil ICLL, SOLAS and MARPOL requirements.

## **D. Additional Services**

### **D 100 Web site**

**101** Description of additional DNV services related to conversion projects within the areas of pre-conversion, class transfer, subsea installations, production facilities and in-service support can be found at the DNV web site [www.dnv.com](http://www.dnv.com).