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OFFSHORE STANDARD  
DNV-OS-E403

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OFFSHORE LOADING BUOYS

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APRIL 2005

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.

DNV Offshore Codes consist of a three level hierarchy of documents:

- *Offshore Service Specifications*. Provide principles and procedures of DNV classification, certification, verification and consultancy services.
- *Offshore Standards*. Provide technical provisions and acceptance criteria for general use by the offshore industry as well as the technical basis for DNV offshore services.
- *Recommended Practices*. Provide proven technology and sound engineering practice as well as guidance for the higher level Offshore Service Specifications and Offshore Standards.

DNV Offshore Codes are offered within the following areas:

- A) Qualification, Quality and Safety Methodology
- B) Materials Technology
- C) Structures
- D) Systems
- E) Special Facilities
- F) Pipelines and Risers
- 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This document is valid until superseded by a new revision.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 on the DNV web-site; normally updated twice per year (April and October). To access the web-site, select short-cut options "Technology Services" and "Offshore Rules and Standards" at <http://www.dnv.com/>

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

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## **Introduction**

The now superseded MOU Class Rules' chapter on offshore loading buoys was not included in the transition from MOU Rules to DNV Offshore Standards, since the MOU Rules were terminated in 2000.

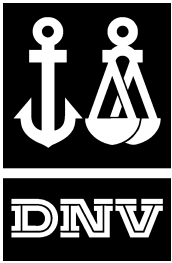
Due to a recent increased activity and demand for DNV services a new DNV Offshore Standard has therefore been developed based on the contents of the withdrawn MOU Rules Pt.5 Ch.5 with updates and additions based on current knowledge and experience feed-back.



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CHAPTER 1

**INTRODUCTION**

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# SECTION 1 INTRODUCTION

## A. General

### A 100 Introduction

**101** This standard gives criteria and guidance on design, fabrication, installation and testing of offshore loading buoys.

**102** The standard applies to floating (i.e. buoy) systems intended for loading/ unloading of fluid cargoes such as crude oil, petroleum gas etc. into/from ships or other units in open sea.

**103** The standard has been written for general worldwide application in benign waters. Buoys intended for harsh environment use shall be subject to special consideration.

Governmental regulations may include requirements in excess of the provisions of this standard depending on the size, type, location and intended service of the offshore loading buoy.

#### Guidance note:

In the context of this Offshore Standard benign waters is defined as areas with significant wave height less than 8.5 m with a probability of exceedance of  $10^{-2}$  (100 years return period).

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### A 200 Objectives

**201** The objectives of this standard are to:

- provide an internationally acceptable standard of safety for offshore loading buoys by defining minimum requirements for the design, materials, construction and commissioning of such objects
- serve as a technical reference document in contractual matters between suppliers and purchasers
- serve as a guideline for designers, suppliers, and purchasers
- specify requirements for offshore loading buoys subject to DNV certification and classification.

### A 300 Organisation of the standard

**301** This standard is divided into three main chapters:

- *Chapter 1:* General information, scope, definitions and references.
- *Chapter 2:* Technical provisions for offshore loading buoys for general application.
- *Chapter 3:* Specific procedures and requirements applicable for certification and classification of offshore loading buoys in accordance with this standard.

### A 400 Scope and application

**401** The standard covers the following systems and arrangements, including relevant equipment and structures:

- arrangements
- loads and load effects
- structural strength
- anchoring and mooring
- stability and watertight integrity
- hazardous areas and ventilation
- marine machinery and piping
- electrical installation
- fluid transfer system and equipment
- instrumentation and control systems.

## B. References

### B 100 General

**101** In case of conflict between requirements of this standard and a reference document, the requirements of this standard shall prevail.

**102** For undated references, the latest edition of the referenced document (including any amendments) applies. For dated references, the edition cited applies.

**103** Codes and standards other than those listed may be acceptable as alternative or supplementary requirements, provided that they can be demonstrated to achieve a comparable, or higher, safety level.

**104** Any deviations, exceptions and modifications to the codes and standards shall be documented and agreed between the contractor, purchaser and verifier, as applicable.

### B 200 Normative references

**201** The referenced documents listed in Table B1 include provisions, which through reference in the text constitute provisions of this standard. The latest issue of the references shall be applied unless otherwise stated or agreed.

**202** Alternative recognised standards may be applied provided it can be demonstrated that these meet or exceed the requirements of the standards referenced below.

**203** Any deviations, exceptions and modifications made in relation to the codes and standards shall be documented and agreed between the supplier, purchaser, and verifier, as applicable.

Table B1 Normative Reference Documents	
Reference	Title
API RP 2RD	Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms (TLPs)
API RP 17B	Recommended Practice for Flexible Pipe
API Spec 17J	Specification for Unbonded Flexible Pipe
API Spec 17K	Specification for bonded flexible pipe".
API RP 1111	Design, Construction, Operation and Maintenance of Offshore Hydrocarbon Pipelines (Limit State Design).
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-C201	Structural Design of Offshore Units (WSD Method)
DNV-OS-C301	Stability and Watertight Integrity
DNV-OS-C401	Fabrication and Testing of Offshore Structures
DNV-OS-C502	Concrete Structures
DNV-OS-D101	Marine and Machinery Systems and Equipment
DNV-OS-D201	Electrical Installations
DNV-OS-D202	Instrumentation and Telecommunication Systems
DNV-OS-D301	Fire Protection
DNV-OS-E201	Hydrocarbon Production Plant
DNV-OS-E301	Position Mooring
DNV-OS-F101	Submarine Pipeline Systems
DNV-OS-F201	Dynamic Risers
DNV	Rules for Certification of Lifting Appliances
DNV	Rules for Flexible Risers and Pipes

ISO 898	Mechanical properties of fasteners
ISO 15156/ NACE MR0175	Materials for use in H <sub>2</sub> S-containing environments in oil and gas production
OCIMF	Guidelines for the Purchasing and Testing of SPM Hawsers
OCIMF	Recommendations for Equipment Employed in the Mooring of Ships at Single Point Moorings
OCIMF	Guide to Purchasing, Manufacturing and Testing of Loading and Discharge Hoses for Offshore Moorings <sup>1</sup> within 100 m water depth,

## C. Definitions

### C 100 Verbal forms

**101 Shall:** Indicates a mandatory requirement to be followed for fulfilment or compliance with the present standard. Deviations are not permitted unless formally and rigorously justified, and accepted by all relevant contracting parties.

**102 Should:** Indicates a recommendation that a certain course of action is preferred or particularly suitable. Alternative courses of action are allowable under the standard where agreed between contracting parties, but shall be justified and documented.

**103 May:** Indicates a permission, or an opinion, which is permitted as a part of conformance with the standard.

**104 Can:** Requirements with can are conditional and indicate a possibility to the user of the standard.

### C 200 Terms and definitions

**201 Alarm:** A combined optical and acoustic signal, where the acoustic part calls the attention of personnel, and the optical part serves to identify the fault.

**202 Alarm systems:** Comprise the total systems for warning of abnormal conditions (including sensors, central units and panels, and devices for calling the attention of the personnel).

**203 Anchoring system:** Equipment needed for the positioning of the buoy.

**204 Benign waters:** Areas where the significant wave height is less than 8.5 m for a probability of exceedance of  $10^{-2}$  (100 years return period).

**205 Buoy:** A floating body, normally of a cylindrical shape, and fitted with mooring equipments necessary to perform the mooring of a vessel and ensuring fluid transfer between production and/or storage unit or onshore installation and the moored vessel.

The buoy normally consists of the following main parts:

- hull (buoy structure) providing buoyancy and stability
- rotating part to which the vessel is moored and allowing weathervane,
- fixed part to which the mooring lines and underbuoy pipes are connected.
- mooring system
- riser system
- fluid transfer system
- auxiliary and safety systems
- accommodation, crane and helideck (as applicable).

**206 Control stations:** Those spaces in which the following equipment and functions are located:

- emergency shutdown system (ESD)
- radio and main internal communication control
- control of the emergency source of power.

**207 Emergency shelter area:** The area comprising facilities for overnight stays, simple catering, sanitary, office facilities and service spaces, as applicable.

**208 Emergency shutdown (ESD):** A system for initiation of, either by central manual controls or automatic, shutdown of all ignition sources and oil transfers on abnormal conditions.

**209 Equipment:** A term used in general to denote all components constituting a system such as pressure vessels, heat exchangers, atmospheric tanks, pumps, compressors, engines, turbines, piping, skids etc.

**210 Fluid transfer area:** The area below and above the deck of the buoy that accommodates piping and equipment containing the loading fluid.

**211 Fluid transfer system:** Denotes the transfer of fluids from the terminating end of riser, at riser top, e.g. connector, a passage for fluid through the buoy and up to the unit moored for loading including loading hose.

**212 Machinery:** A general term used to denote rotating and reciprocating type of equipment.

**213 Minimum design temperature (MDT):** Minimum design operating or ambient start up temperature. The lowest predictable metal temperature occurring during normal operations including start up and shut down situations is to be used. If no thermal insulation is fitted, then ambient temperature shall be used if this is lower than the temperature of the content.

#### Guidance note:

Lowest daily mean temperature may be used as ambient temperature.

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**214 Mooring system:** Equipment needed for mooring ships or other units to the buoy.

**215 Not permanently manned buoy:** A buoy which is occasionally manned for maintenance/testing purposes during loading/unloading.

**216 Offshore loading buoys:** A floating catenary anchored facility needed for loading of ships or other units in the open sea from a stationary source of fluid.

**217 Pressure containing equipment:** Implies in general to equipment or its component subjected to internal and external pressure above or below atmospheric pressure.

**218 Unmanned buoy:** A buoy which is not manned during fluid transfer operation.

**219 Utility area:** An area used for the equipment not handling hydrocarbons.

**220 Utility piping:** A piping for the support systems such as :

- starting air for combustion engines
- cooling water
- steam or thermal fluid heating
- lubricating oil
- hydraulic power supply
- pneumatic power supply
- fuel oil or fuel gas supply
- helicopter fuel
- crude oil and gas used directly from production facilities, where applicable
- vent pipes
- drainage.

### C 300 Abbreviations

**301** Abbreviations as shown in Table C1 are used in this standard.

## D. Documentation

**Table C1 Abbreviations**

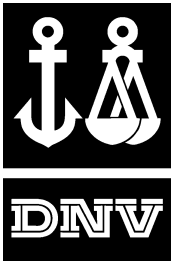
<i>Abbreviations</i>	<i>In full</i>
ANSI:	American National Standards Institute.
API	American Petroleum Institute
BS	British Standards(issued by British Standard Institution).
DNV	Det Norske Veritas
DVR	Design Verification Report
EN	Euro-norm
IEC	International Electrotechnical Committee
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organisation
LEL	Lower Explosion Limit
LRFD	Load and Resistance Factor Design
MSA	Manufacturing Survey Arrangement
NACE:	National Association of Corrosion Engineers.
NDE	Non Destructive Examination
NFPA:	National Fire Protection Association.
OCIMF	Oil Companies International Marine Forum
SPM	Single Point Mooring
SWL	Safe Working Load

### D 100 Design documentation

**101** The following plans and particulars are normally produced to document offshore loading buoys (as applicable):

- buoy structure including fairleads/anchor line stoppers
- turntable and bearings
- universal joints
- loading boom/yoke
- helideck
- superstructure
- anchoring arrangement
- mooring arrangement
- complete specification of fire extinguishers
- drawings showing details such as; the means for access to different enclosed areas.
- general arrangement showing extent of hazardous areas/main layout drawings
- structural analysis
- stability analysis
- anchoring analysis
- mooring analysis
- main particulars for fluid transfer system such as:
  - applicable codes and standards
  - design temperature (min. and max.)
  - design pressure rating
  - fabrication specifications including pipe bending, welding, heat treatment, type and extent of NDE, testing etc.
  - flow sheets of piping and instrumentation diagram (P&ID) with reference to appropriate designation
  - strength calculations.





CHAPTER 2

## TECHNICAL PROVISIONS

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## SECTION 1 LOADING/UNLOADING FACILITIES AND ARRANGEMENTS

### A. General

#### A 100 Application

**101** The requirements in this Section give design principles for systems and equipment related to safety and utility on board the buoy.

### B. Environment and Site Location

#### B 100 General

**101** The buoy shall be suitable for the environmental conditions at the site of location. The following aspects shall be taken into consideration when establishing the environmental loads, as applicable:

- motions of the buoy (i.e. heave, roll, pitch, sway, surge and yaw)
- wind forces
- air and sea temperatures
- waves
- current
- loads from possible snow and ice accumulation, sea ice and icebergs
- tidal variations.

**102** The applicability of the site shall be evaluated and documented with regard to bottom conditions, manoeuvring area and water depth.

**103** Loading buoys intended for operation in cold areas shall be arranged so that water cannot be trapped in local structures or machinery exposed to the ambient temperature.

### C. Arrangements

#### C 100 Structural arrangements

**101** The structural arrangement of the buoy shall be capable of preventing complete structural collapse, loss of floatability or capsizing due to malfunction, mal-operation, collision or other accidental events.

**102** For hawser moorings a detachment criterion shall be established, expressing the worst environmental criterion under which the ship or offshore unit is allowed to remain attached.

##### Guidance note:

For practical purposes the detachment criterion should be related to the hawser tension.

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**103** For buoys provided with yoke connection or other similar systems, the system design is either to be based on environmental conditions with a return period of 100 years or the ship/unit is to be provided with a detachment system which releases when the maximum environmental criteria are exceeded.

#### C 200 Separation of areas

**201** The buoy shall be divided into main areas such as:

- fluid transfer area
- utility area
- emergency shelter area, as applicable.

Each area shall be arranged to reduce the consequences of fire

and explosion.

**202** The need for emergency shelter shall be evaluated for each buoy. Complexity of the buoy, frequency of manning, environmental limitations etc. are to be considered.

**203** Emergency shelter area, when provided on the buoy, shall be separated from the fluid transfer area by A 60 rated fire resisting division.

**204** Where equipment for power generation and distribution, fuel tanks and fire pumps are provided, such equipment shall be located in an utility area. The area is to be enclosed by A 60 rated partitions.

**205** Entrances, air inlets and openings to emergency shelter area shall normally not face the fluid transfer area.

#### C 300 Safety provisions

**301** Requirements for rescue and evacuation means shall be in compliance with relevant National Authority requirements in the area where the buoy will be located.

Normally the following is to be provided as a minimum:

- obstruction lights
- fog signal
- radar reflector
- fire fighting equipment
- identification marks
- lifesaving appliances.

**302** Areas that can be manned shall be provided with an escape route. The escape route shall facilitate escape from all enclosed areas and work stations and is to lead to boat landing and helicopter deck, as applicable.

**303** Escape routes shall be clearly marked.

#### C 400 Equipment and piping

**401** All equipment and parts which are to be operated or subject to inspection and maintenance on board shall be installed and arranged for easy access.

**402** Efficient control apparatus, guards, shields and other means of protecting the personnel shall be incorporated, where necessary.

**403** Where flammable fluids may leak and accumulate, adequate spill collection and drain discharge shall be arranged.

**404** Drain systems for non hazardous and hazardous areas shall be kept separated from each other. For hazardous area classification, ref Sec.7.

**405** Piping containing flammable gases or liquids shall not pass through emergency shelters and control stations.

#### C 500 Precautions against fire

**501** The requirements in DNV-OS-D301 Ch.2 Sec.8 and DNV-OS-D101 Ch.2 Sec.1 A shall be complied with, as applicable.

### D. Marking and Warning Signboards

#### D 100 General

**101** Markings and signboards shall be placed at visible locations.

**102** Warning signs shall be displaced at locations and on machinery when the inadvertent use is dangerous to the safety.

## **E. Fluid Transfer Systems**

### **E 100 General**

**101** Design limits, i.e. maximum and minimum allowable conditions for a component, shall take into account the effects of operational conditions such as start up, change over, run down, hydrate formation, water hammer, and slugs.

**102** When it is essential for the safety that the function of a component is maintained for a specific period of time in the event of fire, the qualifying properties shall be verified.

## **F. Equipment Design**

### **F 100 General**

**101** Equipment or components which are to be lifted for in-

stallation, maintenance etc. shall be provided with properly designed lifting attachment, e.g. lifting lugs.

### **F 200 Loads**

**201** Any part of the equipment shall be designed for the most un-favourable load condition. For each loading condition, and for each component or cross section to be considered, the most un-favourable combination, position and direction of forces, which may act simultaneously shall be used in the analysis.

### **F 300 Design pressure and temperature**

**301** The lowest and highest design temperature at the corresponding maximum design pressure shall be specified with adequate margins to cover uncertainties in the prediction. Both internal and external conditions shall be considered.



## SECTION 2 MATERIALS AND CORROSION PROTECTION

### A. General

#### A 100 Objective

**101** This section provides requirements for materials and corrosion protection applicable to offshore loading buoys.

### B. Principles

#### B 100 General

**101** Selection of materials shall be based on type and level of stresses, temperatures, corrosive and erosive conditions, consequences and possibilities of failure associated with installation, operation and maintenance.

**102** The materials selected shall be suitable for the purpose and have adequate properties of strength and ductility. Materials incorporated in any portion of a system or structure which are critical to the integrity and safety shall have good weldability properties for manufacture and installation, if welding shall be performed. Materials shall be corrosion resistant or protected against corrosion where this is deemed necessary.

**103** Non-combustible materials shall be used. Where any required property does not permit the use of such material, alternative materials may be used subject to agreement between contracting parties.

**104** For selection of acceptable materials suitable for H<sub>2</sub>S contaminated products (sour service), see ANSI/NACE MR0175.

### C. Specific Requirements

#### C 100 Structural materials

**101** Material specifications shall be established for all structural materials. Such materials shall be suitable for their intended purpose and have adequate properties in all relevant design conditions. Material selection shall be undertaken in accordance with the principles given in DNV-OS-C201 Sec.4

**102** Structural materials shall comply with the requirements given in DNV-OS-B101.

#### C 200 Corrosion protection of structures

**201** Corrosion protection of the buoy structure shall comply with DNV-OS-C201 sec.10.

#### C 300 Materials for pressure vessels, piping and equipment

**301** Materials for equipment and piping shall be in accordance with the requirements given by the referred recognised codes.

#### C 400 Bolts and nuts

**401** Bolts and nuts considered as essential for structural and operational safety shall conform to a recognised standard, e.g. ISO 898.

**402** For general service, the specified tensile properties are not to exceed ISO 898 property Class 10.9 when the installation is in atmospheric environment. For equipment submerged in seawater, the tensile properties are not to exceed property class 8.8 or equivalent.

#### Guidance note:

For bolted joints to be part of equipment designed for sulphide stress cracking service, lower tensile properties than for 8.8 class may be necessary in order to comply with ANSI/NACE MR0175.

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#### C 500 Sealing materials and polymers

**501** The materials to be used shall be suitable for the intended service and are to be capable of sustaining the specified operating pressure and temperature of the particular unit or fluid.

### D. Material Certificates

#### D 100 General

**101** All materials for structural application and pressure containing components shall be furnished with documentation stating process of manufacture and heat treatment (metallic materials) together with results of relevant properties obtained through appropriate tests carried out in accordance with recognised standards.

#### Guidance note:

The following mechanical properties shall normally be tested and recorded on a material certificate:

- ultimate tensile strength and yield strength
- elongation and reduction of area
- Charpy V-notch impact toughness
- hardness, where applicable e.g. for sour service
- through thickness properties, where applicable.

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#### D 200 Type of document

**201** Material certificate types shall be as given in Table D1.

Table D1 Material certification	
<i>Certification process</i>	<i>ISO 10474 (EN 10204)</i>
<i>Test report</i> Confirmation by the manufacturer that the supplied products fulfil the purchase specification, and test data from regular production, not necessarily from products supplied	2.2
<i>Work certificate</i> Test results of all specified tests from samples taken from the products supplied. Inspection and tests witnessed and signed by QA department	3.1.B
<i>Test certificate</i> As work certificate, inspection and tests witnessed and signed by an independent third party body	3.1.C

**202** Test certificate shall be required for:

- rolled, forged or cast elements of steel and aluminium for structural application
- plates for boilers and steam heated equipment
- plates for pressure vessels with thickness  $t > 38$  mm
- cast iron and cast steel for use at temperature  $T > 400^{\circ}\text{C}$  or  $pD > 2000$  where  $p$  = pressure in bar,  $D$  = diameter in mm.

**203** Works certificate shall be required for:

- materials for pressure containing and load carrying components which are not included in 202.

**204** Test report are acceptable for other equipment.

## E. Corrosion Protection of Systems and Equipment

### E 100 General

**101** Equipment and piping shall be corrosion resistant or protected against corrosion where considered necessary for safety or operational reasons.

**Guidance note:**

Unprotected carbon steel and stainless steel materials shall not be used for seawater service except for high molybdenum stainless steel or equivalent.

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Corrosion allowance of low alloy carbon steel shall be dependent on corrosivity of commodity, lifetime of equipment and corrosion control method used.

**Guidance note:**

Corrosion allowance in Table E1 is given as guidance.

<b>Table E1 Corrosion allowance "c" for steel materials</b>	
<i>Service <sup>1) 2)</sup></i>	<i>c (mm)</i>
Saturated steam	0.8
Steam coils	2
Feedwater and blowdown pipes (for boilers)	1.5
Compressed air	1.0
Hydraulic oil	0.3
Lubricating oil	0.3
Fuel oil	1
Refrigerants	0.3
Fresh water	0.8
Hydrocarbon service	2
Mud or cement	3
1) An additional allowance for external corrosion shall be considered according to the figures given in the Table, depending on the external medium	
2) Where efficient protective methods against corrosion are used, the corrosion allowance may be reduced up to 50 %	

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**102** Dissimilar metallic materials in contact shall be avoided or adequately protected against galvanic corrosion.

**103** External steel surfaces exposed to the marine atmosphere and splash zone shall be protected by coating. Special metallic materials may be used.

**104** Steel components submerged in seawater shall be externally protected by cathodic protection or a combination of cathodic protection and coating.

**105** Internal corrosion control shall be used if the commodity contains water or has a relative humidity of more than 50 % and if the partial pressure of corrosive gases is above the following limits:

- oxygen: 100 Pa
- hydrogen sulphide: 10 kPa
- carbon dioxide: 20 kPa

Increased corrosivity due to combination of gases shall be considered.

**106** Inhibitors shall be selected when relevant to suit the actual internal environment.

**107** Corrosion monitoring shall be used where considered necessary.

## SECTION 3 STRUCTURAL STRENGTH

### A. General

#### A 100 Application

**101** Special aspects for structural design of offshore loading buoys are given in this section.

**102** General requirements and guidance for structural design by use of working stress method are given in DNV-OS-C201.

**103** Offshore loading buoys may also be designed according to the LRFD (load and resistance factor design) method. General requirements and guidance for structural design by use of LRFD method are given in DNV-OS-C101.

### B. Materials and Structural Categorisation

#### B 100 Materials

**101** General principles and requirements for materials are given in DNV-OS-B101. Selection of steel grades are given in DNV-C201 Sec.4.

**102** Concrete constituents and reinforcements shall comply with DNV-OS-C502.

#### B 200 Structural categorisation

**201** The following elements are normally categorised as special structural elements:

- intersection which incorporates novel construction
- complex padeyes
- external brackets, portion of bulkheads, flats and frames which are designed to receive concentrated loads at major intersections
- highly stressed elements of anchor line attachments.

**202** The following elements are normally categorised as primary structural elements:

- external hull not classified as special
- turntable construction
- bearing support structure
- riser support structure
- yoke construction
- hawser connections
- padeyes and lifting brackets not classified as special
- main support structure for helideck, lifeboat platforms and other important equipment.

**203** The following elements are normally categorised as secondary structural elements:

- bulkheads, stiffeners, flats or decks not categorized as special or primary
- plating of stiffeners of helideck, lifeboat platforms, fenders not taking part in global strength, walkways, etc.

### C. Design Loads

#### C 100 General

**101** Applicable load categories and load categories and load combinations relevant for offshore loading buoys are given in this sub-section.

**102** General definition and specification of load categories is given in DNV-OS-C201 Sec.3.

#### C 200 Functional loads

**201** Functional loads are defined in DNV-OS-C201 Sec.3 D.

**202** Functional loads on decks should normally not be less than the values given in DNV-OS-C201 Sec.3 Table D1.

#### C 300 Environmental loads

**301** Environmental loads are defined in DNV-OS-C201 Sec.3

**302** Variation in hydrostatic pressure and buoyancy on members caused by changes in the water level due to waves and tides shall be regarded as environmental loads.

**303** Unless otherwise documented the local sea pressure acting on the main (weather) deck, sides and bottom shall be taken as:

Main deck:

$$p_{di} = 10 \left( 1 - \frac{d_i}{D} \right)^{0.25} (1 + 0.05L) \quad (kN / m^2)$$

Sides (from main deck to still-water level):

$$p_{si} = p_{di} + 10\gamma(D - z_b) \quad (kN / m^2)$$

Bottom and sides (below still-water level):

$$p_{bsi} = 10\gamma(D - z_b) \quad (kN / m^2)$$

$d_i$  = vertical distance in m from the waterline to the main deck.

$L$  = characteristic maximum horizontal length in m at the still-water draft level.

$D$  = vertical distance in m from the moulded baseline to the main deck, or may alternatively be replaced by the largest relative distance from the moulded baseline to the wave crest if this is proved smaller.

$\gamma$  = reduction factor due to motion of wave particle (0.9 unless otherwise documented).

$z_b$  = vertical distance in m from the baseline to the load point.

**304** The local environmental pressure due to waves shall not be taken less than 10 kN/m<sup>2</sup>.

#### C 400 Accidental loads

**401** Accidental loads are defined in DNV-OS-C201 Sec.3 G.

**402** Any one compartment adjacent to sea shall be assumed flooded.

### D. Loading Conditions

#### D 100 General

**101** Relevant loading conditions by use of the working stress method are given in DNV-OS-C201 Sec.3 B.

#### D 200 Load cases

**201** Operational limitations characterised by the environmental conditions under which the moored ship or unit will remain attached to the buoy shall be established.

**202** The maximum environmental forces acting on the buoy

shall be determined based on likely directions for wind, current and waves.

**203** Relevant design conditions are given in Table D1 and D2.

The loading conditions are defined as follows:

- a) functional loads
- b) maximum environmental loads and associated functional loads
- c) accidental loads and associated functional loads
- d) annual most probable value of environmental loads and associated functional loads after credible failures, or after accidental events

Table D1 Relevant design conditions					
Design condition		Loading condition			
		a)	b) <sup>1,2)</sup>	c) <sup>3)</sup>	d) <sup>3)</sup>
Normal operation		X	X	X	X
Temporary	Construction	X			
	Transportation	X	X		
	Installation	X	X		
	Retrieval		X		
	Modification	X	X		
1) Design in loading condition b) of the buoy includes the moored ship/unit connected and disconnected depending on the service limitations, see Table D2. 2) The structure shall be able to resist expected fatigue loads which may occur during operating design conditions. 3) Design against design conditions c) and d) and fatigue may normally be omitted for design condition, construction, transportation, installation and modification, provided adequate measures are taken to prevent, avoid or control such situations.					

Table D2 Environmental loading		
Loading condition	Detached	Attached
b)	DNV-OS-C201 Sec.3 E "Environmental Loads"	Limiting environmental conditions under which the ship/unit will remain attached

## E. Local Strength

### E 100 General

**101** Scantlings shall be checked against the maximum local forces superimposed on the overall forces.

**102** Scantlings of plates, stiffeners and girders shall comply with the requirements given in DNV-OS-C201 Sec.6. Requirements to weld connections are given in DNV-OS-C201 Sec.9.

### E 200 Slewing bearings

**201** The slewing bearing shall be of sufficient stiffness to prevent harmful deflections.

**202** Requirements for materials and fabrication of slewing bearings are given in DNV *Rules for Certification of Lifting Appliances*.

**203** For slewing bearings of ball and roller type, the following aspects shall be considered:

- plastic deformation of rolling elements and raceways (raceway capacities).
- fatigue of critical local sections of outer and inner rings.
- fatigue of bolts.
- yield limit load (capacity) of the slewing bearing as a whole, based on the capacities of bolts and ring cross sections with due regard to the rigidity of the structures supporting the (fixed and the revolving) rings.

**204** Yield limit load (capacity) of the slewing bearing shall be evaluated considering equilibrium between the rolling element forces and the following reactions acting on an element of the ring:

- bolt forces acting on the considered element, possible shear included
- possible interface pressure between the considered element and the structure supporting the ring
- forces acting in the cross section of the ring (i.e. on the end surfaces of the considered element).

**205** The safety factors for slewing rings shall not be less than:

- 1.7 (i.e. ratio between ultimate carrying capacity (ring and bolts) and calculated load on the slewing ring).
- 1.5 against fatigue referred to stresses (90% probability) applying a load spectrum factor of 0.7.

**206** Bolt material having yield strength exceeding 900 N/mm<sup>2</sup> (10.9 ISO strength class) shall only be used after special consideration and agreement between contracting parties.

**207** Slewing ring fasteners shall be pre-stressed according to a written procedure. The degree of permanent pre-stressing shall be as high as possible without producing yield in bolt material during pre-stressing. The degree of permanent pre-stressing shall at least be 65%, but normally not more than 80% of bolt material yield strength.

**208** The holding down bolts shall, as far as practical, be equally spaced over the 360° circumference.

### E 300 Universal joints

**301** Universal joints used for connection to the ship or offshore unit shall be checked against the maximum load amplitudes as given in D.

**302** Fatigue strength shall normally be checked against estimated stress history or acceptable simplified methods. Bearing bolts shall be pre-tensioned to reduce altering loads.

**303** Materials shall be in accordance with Sec.2.

**304** Bearing surfaces shall be of non corrosive material.

**305** For sealed bearings, lubricating and seals shall be arranged so that penetration of seawater and impurities is prevented.

## SECTION 4 ANCHORING AND MOORING

### A. Anchoring

#### A 100 General

**101** Requirements for anchoring systems are given in DNV-OS-E301.

#### A 200 Special provision for loading buoys

**201** For installations equipped with hawser load monitoring and hose and hawser Quick Disconnect systems the Safety Factors given in DNV-OS-E301 for intact condition may be reduced by 10%.

**202** Damage to the under buoy hoses may be accepted in survival condition provided the damage is limited to the hoses only and the damage of the hoses will not result in pollution. The owner/operator of the installation shall agree to such a design.

**203** Design based on "Intact condition" only may be acceptable provided the Factors given in DNV-OS-E301 for intact condition is increased by a factor of 1.2 and a anchor line failure will not result in a major pollution or major damage to the buoy

#### A 300 Anchors

**301** The conditions of the seabed, based on site investigations, shall be taken into account in the selection of anchor type, see DNV-OS-E301.

#### A 400 Anchor lines

**401** Anchor lines may consist of chain cable, steel wire, fibre ropes or combination of these.

### B. Mooring

#### B 100 Mooring hawsers

**101** Mooring hawsers shall be of a material suitable for off-shore use. Behaviour in wet condition and under cyclic load shall be documented. Attention is to be paid to possible wear of hawsers at critical points.

**102** The mooring hawser(s) and equipment shall not cause incompatibility between the buoy and the moored ship/unit.

**103** For single mooring hawser systems, the hawser shall be designed with a safety factor of 3.0 on the rated static breaking strength.

**104** For double separated mooring hawser systems, each individual hawser shall be designed for the total maximum mooring load with a safety factor of 1.5 of the rated static breaking strength.

**105** Mooring hawsers and associated equipment shall be designed, fabricated, tested and installed in accordance with the requirements of a recognised standard, e.g.:

- OCIMF Guidelines for the Purchasing and Testing of SPM Hawsers
- OCIMF Recommendations for Equipment Employed in the Mooring of Ships at Single Point Moorings

#### B 200 Compensators

**201** Compensators based on steel springs, hydraulic/ pneumatic spring systems, etc. may be used provided they are safely designed.

#### Guidance note:

Normally the chafe chain is to be the weak link.

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## SECTION 5

### STABILITY AND WATERTIGHT INTEGRITY

#### A. General

##### A 100 Application

**101** The requirements in this Section apply to buoys intended for loading/ unloading of fluid cargoes.

##### A 200 Draft marks

**201** Anchored offshore buoys shall have draft marks applied visibly on the outside of the hull indicating maximum permissible draft.

#### B. Intact Stability

##### B 100 General

**101** The intact stability criteria to be taken into account shall be as follows:

- the met centric height shall be positive
- the area under the righting moment curve to the second intercept, or a lesser angle, shall not be taken less than 40% in excess of the area under the heeling moment.

##### B 200 Stability calculations

**201** Intact stability calculations shall be carried out in accordance with principles given in DNV-OS-C301 as applied

for deep-draught units.

**202** The stability shall be calculated in a disconnected mode corresponding to environmental condition with return a period of 100 years.

**203** It is to be verified that loss of single anchor line provides sufficient stability.

#### C. Damage Stability

##### C 100 General

**101** Provisions shall be made to avoid progressive flooding after flooding of at least one compartment. The buoy shall remain afloat without causing damage to the fluid and utility systems. Evacuation of personnel shall be possible in this condition.

##### C 200 Exposed collision zones

**201** Exposed collision zones are those portions of the structure subjected to accidental flooding due to collision with the ship/unit that is normally moored to the buoy. The collision exposed zones shall normally be taken according to DNV-OS-C301 Ch.1 Sec.1 D.

## SECTION 6 PIPING, EQUIPMENT AND HOSES

### A. Piping

#### A 100 General

**101** The fluid transfer piping system shall be in accordance with DNV-OS-E201.

### B. Mechanical Equipment

#### B 100 Bilge and sounding systems

**101** Buoys shall be provided with means for pumping from and draining any watertight compartment. Pumping by means of a portable pump may be accepted.

**102** Watertight compartments shall have provisions for sounding.

#### B 200 Pipe swivel

**201** The pipe swivel shall normally satisfy all the requirements applicable for the comprising piping systems.

**202** Where applicable, the pipe swivel shall be designed for external forces, e.g. forces on combined pipe swivel and rotation bearing of buoy, mooring forces etc.

**203** For pressure and leak proof testing of the pipe swivel, see Sec.11.

#### B 300 Lifting equipment

**301** Structural and mechanical components for lifting equipment shall comply with recognised standards, e.g. DNV Rules for Certification of Lifting Appliances.

**302** Individual components such as sheaves, hooks, shackles, wire slings, permanent attachments, etc. shall be marked with the maximum permissible working load (SWL).

### C. Floating Hoses

#### C 100 General

**101** The dimensions and the type of reinforcement for floating hoses shall be determined from strength analysis of the hose system taking into account design pressure differential, fluid flow, weight of hose with contents, buoyancy forces, wave forces, accelerations and relative motions.

**102** The longitudinal strength requirements shall normally be based on the assumption that the hose acts as a cable, disregarding possible effect of bending moments on the equilibrium configuration. In areas of maximum curvature, special reinforcement or support arrangements may be required to restrict the curvature.

**103** The length of the loading hose shall be determined in accordance with response analysis in order to prevent overstressing or extension beyond its presumed operational configuration.

**104** The hose shall be properly arranged with respect to support and configuration during loading as well as when the terminal is unoccupied in order to restrict the curvature and to reduce change of curvature and thereby fatigue effects. The loading hose shall also be properly protected against fouling

and mechanical damage.

**105** The ship/unit end of the hose shall be provided with suitable means for closure.

**106** The floating hose shall be provided with a weak link.

**107** For floating hoses, depending on buoyancy elements, the floatation media, added as either individual floats or integral floatation, shall be considered with regard to toughness, flexibility and low water absorption.

The attachment points for individual floats shall be designed for suitable transition of point loads.

#### Guidance note:

Normally hoses complying with "Guide to Purchasing, Manufacturing & Testing of Loading & Discharge Hoses for Offshore Moorings" issued by Oil Companies International Marine Forum (OCIMF). will be acceptable.

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### D. Underbuoy Hoses and Pipes

#### D 100 General

**101** Underbuoy hoses and associated components shall be designed, fabricated, tested and installed in accordance with the requirements of a recognised standard, e.g.:

*For rigid underbuoy pipe systems:*

- DNV-OS-F101
- DNV-OS-F201
- API RP 2RD
- API RP 1111

*For non-bonded flexible underbuoy pipe systems:*

- DNV Rules for Flexible Risers and Pipes
- API Spec 17J
- API RP 17B

*For bonded flexible underbuoy pipe systems:*

- OCIMF "Guide to Purchasing, Manufacturing and Testing of Loading and Discharge Hoses for Offshore Moorings" within 100 m water depth
- API Spec 17K

**102** Dynamic analyses shall be performed (fully or partially coupled) with sensitivity to water depth, fluid densities and combinations of environmental conditions (directions). The extreme tension, shear force, curvature along the hose strings is to be assessed in operating and survival conditions, with tanker connected and not connected.

The fatigue life of the underbuoy hoses shall be assessed.

Interference with seabed or anchor lines that may damage the hoses is not permitted.

#### Guidance note:

Floating and underbuoy hoses may be considered as consumable items with expected service life shorter than the design life of the installation. See also OCIMF "Guidelines for the Handling, Storage, Inspection and Testing of Hoses in the Field".

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## **SECTION 7**

### **HAZARDOUS AREA AND VENTILATION**

#### **A. General**

##### **A 100 Application**

**101** The provisions of this section are intended to avoid ignition of potential flammable releases that may occur on the buoy during normal operation. Release as a result of accidental events is not addressed by area classification, but shall be covered by emergency measures.

**102** All offshore loading buoys shall be subjected to hazardous area classification assessment.

**103** General requirements for hazardous area classification are given in DNV-OS-A101.

#### **B. Specific Requirements**

##### **B 100 General**

**101** Flanges and fittings in the fluid transfer system shall be regarded as secondary grade source of release.

**102** Swivel, loading hose connectors and ventilation outlets may be regarded as either primary or secondary source of release depending on frequency of operation and operational experience.

##### **B 200 Enclosed areas**

**201** An enclosed area adjacent to hazardous areas containing no source of release may be classified non-hazardous provided gastight doors/hatches are installed.

**202** Emergency shelter may be accepted without mechanical ventilation provided adequate louvers or similar arrangements are installed.



## **SECTION 8**

### **ELECTRICAL INSTALLATIONS**

#### **A. General**

##### **A 100 Application**

**101** Electrical installations shall comply with DNV-OS-D201, as applicable.

**102** Other codes and standards such as IEEE, NFPA, IEC, BS or similar may be applied upon consideration in each case.

## SECTION 9 FIRE SAFETY

### A. General

#### A 100 Application

**101** Fire protection, detection and extinction shall be according to DNV-OS-D301, as applicable.

**102** Attention is to be given to any statutory requirements of the National Authority having jurisdiction in the waters where the buoy is located.

### B. Specific Requirements for Offshore Loading Buoys

#### B 100 General

**101** The arrangement of fire control and extinguishing shall be adequate for the buoy during its intended operation. Compensating procedures and measures, e.g. standby vessel with fire fighting equipment during manned periods shall be credited.

**102** All fire-extinguishing appliances shall be kept in good order and shall be available for immediate use.

#### B 200 Unmanned buoys

**201** An unmanned buoy does not require permanent arrangement for fire control and extinction.

#### Guidance note:

Examples are simple buoys without helicopter deck, boat-landing or working platforms.

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#### B 300 Not permanently manned buoys

**301** A buoy that may be manned for maintenance or testing purposes shall be equipped with fire control and fire extinction systems, including:

- approved portable fire extinguishers shall be provided in service and working spaces
- emergency shelter and other enclosed areas, e.g. for machinery
- electrical power generation and distribution shall be arranged with a fixed fire extinguishing system as outlined in DNV-OS-D301
- provision for helicopter facilities.

**302** Helicopter facilities shall in principle comply with the requirements in DNV-OS-D301 Sec.5. For installations where adequate arrangement of fire control and fire extinction for the buoy is achieved without the provision of a fire pump, fixed dry powder system of capacity 250 kg is at least to be installed.

## SECTION 10 CONTROL SYSTEMS

### A. General

#### A 100 Application

**101** The requirements in this section covers the following aspects:

- control of fluid transfer
- communication
- gas detection system, where applicable
- alarm, where applicable.

**102** Control, monitoring and shutdown functions shall to be according to DNV-OS-E201, as applicable.

### B. Basic Requirements

#### B 100 Control of fluid transfer

**101** The loading system shall be provided with fluid transfer monitoring display either at a local or central control station.

**102** The control system shall be designed so that pumps can not be operated until specific valves are opened and the connection to the loading ship/unit has been successfully completed. The pumps shall stop immediately upon commencement of an emergency disconnection procedure.

**103** Pressure sensors shall be located at suitable positions to secure loading pump shut down if the line pressure exceeds the maximum allowable pressure by a preset amount or drops below a preset minimum value.

**Guidance note:**

Pressure sensors that are installed on board the ship/unit's loading pumps may be accepted.

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**104** Interlocks shall be provided to ensure that:

- main control valves can not be opened unless the coupling is connected to the mating flange
- outboard and inboard valves adjacent to the coupling are closed before the coupling can be released.

**Guidance note:**

Operational procedures may replace physical interlocks.

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**105** Accumulators shall be provided for hydraulic operated valves. The accumulators shall be of sufficient capacity to close the valves and release the coupling.

**106** Pressure relief, depressurising and disposal systems are to be according to DNV-OS-E201, as relevant.

#### B 200 Communication

**201** A two way communication system on the buoy and a continuously manned control station on a neighbouring installation or a stand by vessel shall be provided whenever the buoy is manned.

**202** In order to ensure reliable communication, equipment duplication is required.

**203** The communication may be arranged by portable or permanent equipment on the buoy or combination thereof.

**204** A two way communication between the control station in command of loading operation and the ship/unit shall be established before connecting to the buoy. The communication shall be maintained during loading.

### C. Gas Detection System

#### C 100 General

**101** Buoys that may be manned for maintenance/testing purposes shall be monitored for flammable gas. Monitoring may be performed by a permanently installed system or portable equipment. Upon entering the buoy, all areas shall be checked for flammable gas.

**102** The gas detection system shall give audible alarm when a concentration of 25% of lower explosion limit (LEL) for hydrocarbon gas is reached.

**103** Where a permanently installed system is provided, automatic shutdown of the installation shall take place when 60% LEL is reached, or gas is detected in or at a non hazardous area.

### D. Alarm System

#### D 100 General

**101** Buoys with enclosed areas or otherwise arranged such that personnel onboard cannot be readily aware of a dangerous situation shall be equipped with a suitable alarm system.

**102** The alarm system shall be connected to an emergency source of power.

**103** Areas protected by gas extinguishing systems, shall be provided with alarm inside the area before discharge.

**104** Emergency shelter areas shall be equipped with smoke detectors releasing audible alarm in case of fire.

## SECTION 11

### MANUFACTURE, SEA TRANSPORT AND COMMISSIONING

#### A. General

##### A 100 Application

**101** This section provides requirements for:

- fabrication of buoy structure
- manufacture of equipment
- sea transport
- installation and commissioning.

**102** The fabrication and testing of structures shall comply with DNV-OS-C401.

**103** The manufacture, installation and testing of components and equipment systems, e.g. pressure vessels, piping, machinery on skids, shall comply with DNV-OS-E201.

- two complete revolutions in each direction at a rate of approximately ten minutes per revolution.
- four complete revolutions: The first revolution is to be clockwise and the final anti-clockwise. Each rotation is to be in stages of 30 degrees at a rate of approximately one degree per second with a 30 second degrees rotation. The breakaway torque and the rotating torque shall be recorded. Where the fluid assembly swivel rotates in unison with the mooring swivel, concentricity of the fluid and mooring swivel shall be demonstrated.

##### B 200 Torsional seals

**201** Hydrostatic shop pressure testing shall be conducted to 1.5 times the design pressure.

#### B. Manufacture of Equipment and Piping

##### B 100 Pipe swivel

**101** The pipe swivel assembly shall be hydrostatically shop tested as follows:

- a) 1.5 times design pressure for at least 2 hours with no leakage and without considerable pressure drop.
- b) At design pressure with no leakage and with rotations as below:

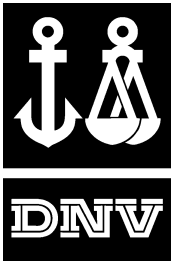
#### C. Installation and Commissioning

##### C 100 Installations

**101** Testing procedure for anchors shall be according to DNV-OS-E301.

##### C 200 Pre-commissioning

**201** Prior to commissioning, all systems shall be tested according to written procedures.



CHAPTER 3

## CERTIFICATION AND CLASSIFICATION

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## SECTION 1 CERTIFICATION AND CLASSIFICATION

### A. General

#### A 100 Introduction

**101** As well as representing DNV's recommendations of good engineering practice for general use by the offshore industry, the offshore standards also provide the technical basis for DNV classification, certification and verification services.

#### A 200 Definitions

**201** *Client:* The applicant for the certificate who may be either the yard, the owner, or with regard to components, the manufacturer.

### B. Certification

#### B 100 General

**101** Upon request from a Client, a certificate to a buoy may be issued for a complete installation which has been designed, built, inspected and tested in compliance with this Offshore Standard and applicable codes, standards and regulations.

**102** Applicable codes, standards and regulations as well as operational limitations and basic assumptions and conditions for use will be stated in the Certificate.

### C. Classification

#### C 100 General

**101** Buoys designed, built, installed, tested and intended to be followed up in-service under supervision of the Society in compliance with the requirements of this standard will be entitled to the Class Notation: **Offshore Loading Buoy**.

**102** A complete description of principles, procedures, applicable class notations and technical basis for offshore classification is given by DNV-OSS-102 "*Rules for Classification of Floating Production and Storage Units*".

**103** Due to the particular nature of offshore loading buoys' operations and ownership, the precise scope of classification shall be decided on a case-by case basis after agreement with the client.

**104** The extent of classification is identified in the Appendix to Class Certificate.

The following is normally included:

- arrangements
- structural strength
- anchoring and mooring
- stability and watertight integrity
- hazardous areas and ventilation
- marine machinery and piping
- electrical installation
- fluid transfer system and equipment
- instrumentation and control systems.

**105** Loading/unloading systems shall be approved according to the following principles:

- design approval
- survey of fabrication
- survey of installation
- functional test after installation.

#### C 200 Assumptions

**201** It is assumed that all marine operations necessary for construction, transportation and installation of buoy are conducted by competent personnel and that the operating planning is based on experience and sound engineering practice. It is also assumed that the conditions during the actual marine operations do not depart from those assumed.

**202** Limitations for operation, systems and equipment will be included in the Appendix to Classification Certificate.

#### C 300 National regulations

**301** Some items because of their specific nature are assumed to be controlled by National Authorities and hence are not considered to be within the scope of Classification. These items include:

- arrangement for personnel safety on board, i.e. stairs, ladders, access ways etc.
- evacuation and lifesaving appliances
- navigation/obstruction aids
- temporary equipment/installation, e.g. for storage, operation, maintenance etc.

## SECTION 2 DESIGN APPROVAL

### A. General

#### A 100 General

**101** This section gives requirements for certification and classification related to design.

**102** When deemed necessary, the Society may require that special studies or calculations are performed in order to define particular operational limitations.

- mooring analysis
- main particulars for fluid transfer system such as:
- applicable codes and standards
- design temperature (min. and max.)
- design pressure rating
- fabrication specifications including pipe bending, welding, heat treatment, type and extent of NDE, testing etc.
- flow sheets of piping and instrumentation diagram (P&ID) with reference to appropriate designation
- strength calculations.

### B. Documentation

#### B 100 Design documentation

**101** The following plans and particulars shall be submitted for approval, as applicable:

- buoy structure including fairleads/anchor line stoppers
- turntable and bearings
- universal joints
- loading boom/yoke
- helideck
- superstructure
- anchoring arrangement
- mooring arrangement
- arrangement of fluid transfer systems with following information to be included:
  - materials to be applied for pipes, hoses, fittings, branches, unions, plugs, flanges, bolts, nuts, gaskets, etc.
  - materials to be applied for valve bodies, bonnets, stems, seat seals, springs, actuators, etc.
  - corrosion allowances
  - wall thickness listed for each applicable line size
  - rating and type of flanges, valves, fittings, branches, unions, and type of gaskets, etc.
  - drawings or certified proof test reports for non-standard piping components
  - pressure test plan
- complete specification of fire extinguishers
- drawings showing details such as the means for access to different enclosed areas.

**102** The following plans, descriptions and calculations shall be submitted for information, as applicable:

- general arrangement showing extent of hazardous areas/main layout drawings
- structural analysis
- stability analysis
- anchoring analysis

### C. Stability and Watertight Integrity

#### C 100 General

**101** For simple unmanned buoys, other stability requirements may be considered by the Society.

### D. Piping, Equipment and Loading Hoses

#### D 100 Torsional seals

**101** If torsional seals are used, a prototype test may be required by the Society.

### E. Survey Arrangement

#### E 100 General

**101** A "facility plan" for in service inspection shall be submitted for approval. The plan is to show the types of facilities which are or will be provided to make important structural parts accessible for survey in accordance with the in-service inspection programme.

**102** Annual and special surveys may be carried out on location based on approved procedures outlined in a maintenance system and survey arrangement, without interrupting the function of the installation.

The following matters will be taken into consideration for acceptance of surveys to be carried out on location:

- arrangement for underwater inspection of structure and openings affecting the floatability of the buoy
- means for blanking off all openings
- accessibility of all spaces for inspection
- corrosion protection of structure
- testing facilities for equipment, as applicable.



## SECTION 3 CERTIFICATION OF MATERIALS AND EQUIPMENT

### A. Certification of Materials

#### A 100 General

**101** Certification of materials shall be carried out as described in Ch.2 Sec.2 D.

**102** For DNV classification projects the test certificates shall be DNV material certificates in compliance with the requirements given in DNV-OS-B101.

### B. Certification of Components and Equipment

#### B 100 General

**101** Components and equipment shall be certified consistent with its functions and importance for safety.

**102** Equipment referred to in this standard will be categorised as follows:

*Category I:*

- equipment related to safety for which a DNV certificate is required.
- category I equipment is subdivided into IA and IB categorisation.

*Category II:*

- equipment related to safety for which a works certificate prepared by the manufacturer is accepted.

**103** For equipment category I, the following approval procedure shall be followed:

- design approval, followed by a design verification report (DVR) or type approval certificate.
- fabrication survey followed by issuance of a product certificate.

**104** Depending on the required extent of survey, category I equipment is subdivided into IA and IB with the specified requirements as given below.

#### Guidance note:

It should be noted that the scopes defined for category IA and IB are typical and adjustments may be required based on considerations such as:

- complexity and size of a delivery
- previous experience with equipment type
- maturity and effectiveness of manufacturer's quality assurance system
- degree of subcontracting.

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*Category IA:*

- pre-production meeting, as applicable, prior to the start of fabrication.
- class survey during fabrication.
- witness final functional, pressure and load tests, as applicable.
- review fabrication record.

*Category IB:*

- pre-production meeting (optional).
- witness final functional, pressure and load tests, as applicable.

- review fabrication record.

The extent of required survey by DNV is to be decided on the basis of manufacturer's QA/QC system, manufacturing survey arrangement (MSA) with DNV and type of fabrication methods

**105** Equipment of category II is normally accepted on the basis of a works certificate prepared by the manufacturer. The certificate shall contain the following data as a minimum:

- equipment specification or data sheet.
- limitations with respect to operation of equipment.
- statement (affidavit) from the manufacturer to confirm that the equipment has been constructed, manufactured and tested according to the recognised methods, codes and standards.

#### Guidance note:

Independent test certificate or report for the equipment or approval certificate for manufacturing system may also be accepted.

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### C. Equipment Categorisation

#### C 100 General

**101** Categorisation of equipment normally installed is given in Table C1. Equipment considered to be important for safety, which is not listed, shall be categorised after special consideration.

**Table C1 Category for pressure containing equipment**

Component	Conditions	Category	
		IB <sup>1)</sup>	II
Piping spools	Wall thickness > 25,4 mm (1 inch)	X	
	Design temperature > 400°C	X	
	Longitudinally welded pipes for flammable/toxic fluids	X	
	Longitudinally welded pipes for non-flammable/non-toxic fluids		X
Flanges and couplings <sup>1)</sup>	Standard type		X
	Non-standard type flanges and couplings for flammable/toxic fluids	X	
Valves <sup>2)</sup>	Valve body of welded construction with ANSI rating > 600 lbs	X	
	Valves designed and manufactured in accordance with recognised standards		X
Safety valves and rupture discs	All	X	
Expansion joints	For flammable or toxic fluids	X	

<b>Table C1 Category for pressure containing equipment (Continued)</b>			
<i>Component</i>	<i>Conditions</i>	<i>Category</i>	
		<i>IB <sup>1)</sup></i>	<i>II</i>
Flexible hoses	For flammable or toxic fluids	X	
Swivels and torsional seals	All	X	
Components above when made of high strength material	Specified yield strength > 345 MPa (50000 psi) or tensile strength > 515 MPa (75000 psi)	X	
1) The extent for witnessing tests may be agreed upon with the Society based on manufacturer's QA/QC system. 2) Applicable only for piping components in systems with those media referred to in Table C1.			

**102** Mooring equipment such as mooring hawsers, yokes and connecting links is subject to certification. The certification may be based on internationally recognised codes and standards as referred to.

## SECTION 4

### SURVEY DURING CONSTRUCTION

#### A. General

##### A 100 General

**101** General description of activities related to survey during construction is given in DNV-OSS-Ch.1 Sec.4 Classification Procedure.

**102** Detail scope of survey is given in Ch.3 of the relevant

DNV Offshore Standards (as applicable):

- DNV-OS-C401 for structural fabrication
- DNV-OS-D101 for mechanical systems
- DNV-OS-D201 for electrical installations
- DNV-OS-D202 for instrumentation
- DNV-OS-E201 for hydrocarbon related systems.

## SECTION 5

### SURVEYS AT TESTING AND INSTALLATION

#### A. Pre-commissioning

##### A 100 General

**101** Prior to commissioning, all systems shall be tested according to approved procedures.

**102** Procedures for hook-up at site, if applicable, and pre-commissioning tests shall be agreed with the Society in each case.

**103** The Society's Surveyor is to be requested to inspect the buoy and attend the final tests, as necessary.

**104** Equipment with "category I" for which the functional and or performance tests are not witnessed at manufacturer's place, shall be tested after installation and witnessed by the Society's surveyor.

**105** A record of pressure valve setting shall be made available to the Society's surveyor on request.

**106** Function, performance testing of the following systems and equipment shall be in accordance with a written test programs accepted by the Society's surveyor:

- fluid transfer system
- riser connections
- mooring hawser tensioning system
- ventilating systems for hazardous area, where applicable
- fire extinction and deluge systems, where applicable
- alarm and intercommunication systems.

**107** Any modifications after testing shall be in agreement with the Society.

## SECTION 6

### CLASSIFICATION IN OPERATION

#### A. General

##### A 100 General

**101** In order to maintain class in the operational phase, classed loading buoys are required to undergo periodical surveys. The objective of the surveys is to ascertain that the con-

dition of the structure, systems and equipment covered by class meet, and will continue to meet, the applicable class requirements.

**102** Periodical survey principles and requirements for retention of class in the operational phase is given in DNV-OSS-102.

