OFFSHORE STANDARD
DNV-OS-E403

OFFSHORE LOADING BUOYS

OCTOBER 2008

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

O) Subsea Systems

Amendments and Corrections

Whenever amendments and corrections to the document are necessary, the electronic file will be updated and a new Adobe PDF file will be generated and made available from the Webshop (http://webshop.dnv.com/global/).

Comments may be sent by e-mail to *rules@dnv.com*
For subscription orders or information about subscription terms, please use *distribution@dnv.com*
Comprehensive information about DNV services, research and publications can be found at *http*://www.dnv.com, or can be obtained from DNV, Veritasveien 1, NO-1322 Høvik, Norway; Tel +47 67 57 99 00, Fax +47 67 57 99 11.

© Det Norske Veritas. All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording, without the prior written consent of Det Norske Veritas.

Computer Typesetting (FM+SGML) by Det Norske Veritas.

If any person suffers loss or damage which is proved to have been caused by any negligent act or omission of Det Norske Veritas, then Det Norske Veritas shall pay compensation to such person for his proved direct loss or damage. However, the compensation shall not exceed an amount equal to ten times the fee charged for the service in question, provided that the maximum compensation shall never exceed USD 2 million.
In this provision "Det Norske Veritas" shall mean the Foundation Det Norske Veritas as well as all its subsidiaries, directors, officers, employees, agents and any other acting on behalf of Det Norske Veritas.

CHANGES

- **General**

Being class related, this document is published electronically only (as of October 2008) and a printed version is no longer available. The update scheme for this category of documents is different compared to the one relevant for other offshore documents (for which printed versions are available).

For an overview of all types of DNV offshore documents and their update status, see the "Amendments and Corrections" document located at: http://webshop.dnv.com/global/, under category "Offshore Codes".

- **Main changes**

Since the previous edition (April 2005), this document has been amended, latest in October 2008. All changes have been incorporated.

CONTENTS

CH. 1 INTRODUCTION 7

Sec. 1 Introduction..... 9

A. General..... 9
A 100 Introduction..... 9
A 200 Objectives 9
A 300 Organisation of the standard..... 9
A 400 Scope and application 9

B. References 9
B 100 General..... 9
B 200 Normative references..... 9

C. Definitions 10
C 100 Verbal forms 10
C 200 Terms and definitions 10
C 300 Abbreviations..... 10

D. Documentation..... 11
D 100 Design documentation 11

CH. 2 TECHNICAL PROVISIONS 13

Sec. 1 Loading/Unloading Facilities and Arrangements 15

A. General..... 15
A 100 Application..... 15

B. Environment and Site Location 15
B 100 General..... 15

C. Arrangements..... 15
C 100 Structural arrangements 15
C 200 Separation of areas..... 15
C 300 Safety provisions..... 15
C 400 Equipment and piping..... 15
C 500 Precautions against fire..... 15

D. Marking and Warning Signboards..... 15
D 100 General..... 15

E. Fluid Transfer Systems..... 16
E 100 General..... 16

F. Equipment Design 16
F 100 General..... 16
F 200 Loads..... 16
F 300 Design pressure and temperature..... 16

Sec. 2 Materials and Corrosion Protection 17

A. General..... 17
A 100 Objective..... 17

B. Principles 17
B 100 General..... 17

C. Specific Requirements..... 17
C 100 Structural materials..... 17
C 200 Corrosion protection of structures 17
C 300 Materials for pressure vessels, piping and equipment 17
C 400 Bolts and nuts 17
C 500 Sealing materials and polymers..... 17

D. Material Certificates 17
D 100 General..... 17
D 200 Type of document..... 17

E. Corrosion Protection of Systems and Equipment..... 18
E 100 General..... 18

Sec. 3 Structural Strength 19

A. General..... 19
A 100 Application 19

B. Materials and Structural Categorisation 19
B 100 Materials 19
B 200 Structural categorisation 19

C. Design Loads 19
C 100 General..... 19
C 200 Functional loads..... 19
C 300 Environmental loads 19
C 400 Accidental loads..... 19

D. Loading Conditions 19
D 100 General..... 19
D 200 Load cases..... 19

E. Local Strength..... 20
E 100 General..... 20
E 200 Slewing bearings..... 20
E 300 Universal joints..... 20

Sec. 4 Anchoring and Mooring 21

A. Anchoring 21
A 100 General..... 21
A 200 Special provision for loading buoys 21
A 300 Anchors..... 21
A 400 Anchor lines..... 21

B. Mooring 21
B 100 Mooring hawsers 21
B 200 Compensators 21

Sec. 5 Stability and Watertight Integrity 22

A. General..... 22
A 100 Application 22
A 200 Draft marks 22

B. Intact Stability..... 22
B 100 General..... 22
B 200 Stability calculations..... 22

C. Damage Stability 22
C 100 General..... 22
C 200 Exposed collision zones..... 22

Sec. 6 Piping, Equipment and Hoses 23

A. Piping..... 23
A 100 General..... 23

B. Mechanical Equipment 23
B 100 Bilge and sounding systems..... 23
B 200 Pipe swivel..... 23
B 300 Lifting equipment 23

C. Floating Hoses 23
C 100 General..... 23

D. Underbuoy Hoses and Pipes 23
D 100 General..... 23

Sec. 7 Hazardous Area and Ventilation 24

A. General..... 24
A 100 Application 24

B. Specific Requirements..... 24
B 100 General..... 24
B 200 Enclosed areas 24

Sec. 8 Electrical Installations 25

A. General 25
A 100 Application 25

Sec. 9 Fire Safety 26

A. General 26
A 100 Application 26

B. Specific Requirements for Offshore Loading Buoys 26
B 100 General 26
B 200 Unmanned buoys 26
B 300 Not permanently manned buoys 26

Sec. 10 Control Systems 27

A. General 27
A 100 Application 27

B. Basic Requirements 27
B 100 Control of fluid transfer 27
B 200 Communication 27

C. Gas Detection System 27
C 100 General 27

D. Alarm System 27
D 100 General 27

Sec. 11 Manufacture, Sea Transport and Commissioning 28

A. General 28
A 100 Application 28

B. Manufacture of Equipment and Piping 28
B 100 Pipe swivel 28
B 200 Torsional seals 28

C. Installation and Commissioning 28
C 100 Installations 28
C 200 Pre-commissioning 28

CH. 3 CERTIFICATION AND CLASSIFICATION 29

Sec. 1 Certification and Classification 31

A. General 31
A 100 Introduction 31
A 200 Definitions 31

B. Certification 31
B 100 General 31

C. Classification 31
C 100 General 31
C 200 Assumptions 31
C 300 National regulations 31

Sec. 2 Design Approval 32

A. General 32
A 100 General 32

B. Documentation 32
B 100 Design documentation 32

C. Stability and Watertight Integrity 32
C 100 General 32

D. Piping, Equipment and Loading Hoses 32
D 100 Torsional seals 32

E. Survey Arrangement 32
E 100 General 32

Sec. 3 Certification of Materials and Equipment..... 33

A. Certification of Materials 33
A 100 General 33

B. Certification of Components and Equipment 33
B 100 General 33

C. Equipment Categorisation 33
C 100 General 33

Sec. 4 Survey during Construction 35

A. General 35
A 100 General 35

Sec. 5 Surveys at Testing and Installation 36

A. Pre-commissioning 36
A 100 General 36

Sec. 6 Classification in Operation 37

A. General 37
A 100 General 37

OFFSHORE STANDARD
DNV-OS-E403

OFFSHORE LOADING BUOYS

CHAPTER 1

INTRODUCTION

CONTENTS PAGE

Sec. 1 Introduction 9

DET NORSKE VERITAS

Veritasveien 1, NO-1322 Høvik, Norway Tel.: +47 67 57 99 00 Fax: +47 67 57 99 11

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).

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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	Standard for Certification No. 2.22 Lifting Appliances

DNV	Rules for Flexible Risers and Pipes
ISO 898	Mechanical properties of fasteners
ISO 15156/ NACE MR0175	Materials for use in H2S-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" 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 equipmentas 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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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.

Table C1 Abbreviations	
Abbreviations	*In full*
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. Documentation

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.

OFFSHORE STANDARD
DNV-OS-E403

OFFSHORE LOADING BUOYS

CHAPTER 2

TECHNICAL PROVISIONS

CONTENTS PAGE

Sec. 1 Loading/Unloading Facilities and Arrangements 15
Sec. 2 Materials and Corrosion Protection 17
Sec. 3 Structural Strength 19
Sec. 4 Anchoring and Mooring 21
Sec. 5 Stability and Watertight Integrity 22
Sec. 6 Piping, Equipment and Hoses 23
Sec. 7 Hazardous Area and Ventilation 24
Sec. 8 Electrical Installations 25
Sec. 9 Fire Safety 26
Sec. 10 Control Systems 27
Sec. 11 Manufacture, Sea Transport and Commissioning 28

DET NORSKE VERITAS

Veritasveien 1, NO-1322 Høvik, Norway Tel.: +47 67 57 99 00 Fax: +47 67 57 99 11

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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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 installation, 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_2S 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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D 200 Type of document

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

Table D1 Material certification

Certification process	*ISO 10474 (EN 10204)*
Test report 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
Work certificate 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
Test certificate 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°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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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.

Table E1 Corrosion allowance "c" for steel materials

Service [1) 2)]	*c (mm)*
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 %

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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 bereplaced by the largest relative distance from the moulded baseline to the wave crest if this is proved smaller.
γ = 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^2.

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)* [1,2]	*c)* [3]	*d)* [3]
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 *Standard for Certification No. 2.22 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^2 (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 offshore 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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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 Standard for Certification No. 2.22 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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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".

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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 arc 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 an 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.

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:

— 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.

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.

OFFSHORE STANDARD
DNV-OS-E403

OFFSHORE LOADING BUOYS

CHAPTER 3

CERTIFICATION AND CLASSIFICATION

CONTENTS PAGE

Sec. 1 Certification and Classification 31
Sec. 2 Design Approval 32
Sec. 3 Certification of Materials and Equipment 33
Sec. 4 Survey during Construction 35
Sec. 5 Surveys at Testing and Installation 36
Sec. 6 Classification in Operation 37

DET NORSKE VERITAS

Veritasveien 1, NO-1322 Høvik, Norway Tel.: +47 67 57 99 00 Fax: +47 67 57 99 11

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.

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
- 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.

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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

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 [1)]	*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 [1)]	Standard type		X
	Non-standard type flanges and couplings for flammable/toxic fluids	X	
Valves [2)]	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	

Table C1 Category for pressure containing equipment (Continued)

Component	*Conditions*	*Category*	
		IB [1)]	*II*
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 condition 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.