

Integrity of offshore structures

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Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable for most standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with support by The Norwegian Oil Industry Association (OLF), The Federation of Norwegian Industry, Norwegian Shipowners' Association and The Petroleum Safety Authority Norway.

NORSOK standards are administered and published by Standards Norway.

Introduction

This NORSOK standard is the principal standard for offshore structures. The standard especially refers to ISO 19900, *Petroleum and natural gas industries - General requirements for offshore structures*.

It is the intention to revise this NORSOK standard as soon as the International Standards adequately covering the scope of this NORSOK standard have been published.

Changes since last edition are as follows:

- the reference list is updated;
- 4.2 is changed;
- new 4.8 related to interface assessment;
- 7.10 is changed, with new list items b) and i);
- new 7.13 Design of weak links;
- some minor editorial updates.

1 Scope

This NORSOK standard specifies general principles and guidelines for the design and assessment of offshore facilities, and the verification of load bearing structures and related maritime systems subjected to foreseeable actions.

This NORSOK standard is applicable to all types of offshore facilities used in the petroleum activities, including bottom founded facilities as well as floating facilities.

This NORSOK standard is applicable to different types of materials used including steel, concrete, aluminium, etc.

This NORSOK standard is applicable to all structural parts of a facility including substructures, topside structures, vessel hulls, foundations, mooring systems, and subsea facilities. The standard is also applicable to crane pedestals, living quarters, maritime systems, helicopter decks, module support frames and structural parts of lifeboat launching appliances.

This NORSOK standard specifies principles that are applicable also to the successive stages in construction (i.e. fabrication, transportation and installation), to the use of the facility during operation, and to its final disposal.

This NORSOK standard also specifies principles applicable to the assessments of existing facilities, as required, when

- the structure and related maritime systems has experienced damage or deterioration,
- changes deviate from the original design basis. Such changes would include
 - changes in manning,
 - changes to facilities,
 - modifications of existing facility,
 - more onerous environmental criteria,
 - more onerous component or foundation resistance criteria,
 - physical changes to the design basis such as scour and subsidence,
 - inadequate freeboard.
- extension of intended design service life.

Aspects related to verification and quality control are also addressed.

2 Normative and informative references

The following standards include provisions and guidelines which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet the requirements of the referenced standards.

Note Some clauses in this standard refer to specific clauses in the normative references. These references are based upon the editions at the time of issuing this standard.

2.1 Normative references

DNV-OS-C501,	Composite Components
EN 1990,	Eurocode – Basis of structural design
EN 1999 (all parts),	Eurocode 9: Design of aluminium structures
ISO 19900,	Petroleum and natural gas industries – General requirements for offshore structures
ISO 19901-1	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 1: Metocean design and operating considerations
ISO 19901-4,	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 4: Geotechnical and foundation design considerations
ISO 19901-5,	Petroleum and natural gas industries – Specific

	requirements for offshore structures – Part 5: Weight control during engineering and construction
ISO 19901-7,	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 7: Station keeping systems for floating offshore structures and mobile offshore units
ISO 19903,	Petroleum and natural gas industries – Fixed concrete offshore structures
MARPOL,	Consolidated edition of 2006, Annex I, Reg. 19.3.1 and 19.3.2
MEPC.139(53),	Guidelines for the application of the revised MARPOL Annex I. Requirements to floating production, storage and offloading facilities (FPSOs) and floating storage units (FSUs)
NORSOK G-001,	Marine soil investigations
NORSOK M-001,	Materials selection
NORSOK M-101,	Structural steel fabrication
NORSOK M-102,	Structural aluminium fabrication
NORSOK M-120,	Material data sheets for structural steel
NORSOK M-121,	Aluminium structural materials
NORSOK M-501,	Surface preparation and protective coating
NORSOK M-503,	Cathodic protection
NORSOK N-003,	Actions and action effects
NORSOK N-004,	Design of steel structures
NORSOK N-005,	Condition monitoring of load bearing structures
NORSOK N-006,	Assessment of structural integrity for existing offshore load-bearing structures
NORSOK S-002,	Working environment
NORSOK Z-001,	Documentation for operation (DFO)
NMD: Regulations of 23 December 2010 No. 998,	Regulations concerning anchoring /positioning on mobile offshore units
NMD: Regulations of 20 December 1991 No. 878,	Regulations concerning stability, watertight subdivision and watertight/weathertight closing means on mobile offshore units
NMD: Regulations of 20 December 1991 No. 879,	Regulations concerning ballast systems on mobile offshore units
NMD: Regulations of 10 February 1994 No. 123,	Regulations for mobile offshore units with production plants and equipment
NMD: Regulations of 1 April 1996 No. 319,	Regulations concerning certificates of competency and qualification requirements for the manning of mobile offshore units
NPD letter of semi submersibles	Jack-up units – Load carrying structures marine systems and equipment – Co-operation between British and Norwegian authorities, 1.4.2003
NS 3473E,	Concrete structures – Design and detailing rules NOTE NS 3473E is withdrawn, but for the purpose of this NORSOK standard, reference to NS3473E is valid This standard can be found as withdrawn standard on www.standard.no.
Petroleum Act,	The Norwegian parliament: Act 29 November 1996 No. 72 relating to petroleum activities
PSA: The Management Regulations,	Regulations relating to management and the duty to provide information in the petroleum activities and at certain onshore facilities
PSA: The Facility Regulations,	Regulations relating to design and outfitting of facilities etc. in the petroleum activities
PSA: The Activities Regulations,	Regulations relating to conducting petroleum activities

PSA letter on jack-ups as of 05.01.2006	PSA: Ageing of jack-up units – Load carrying structures marine systems and equipment, 5.1.2006
VMO standards	As defined in DNV-OS-H101 Marine Operations, General.

NOTE Reference to PSA regulations is normative only for NCS.

2.2 Informative references

API RP 2A,	Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms
DNV-OS-C101,	Design of Offshore Steel Structures, General (LRFD-method)
DNV-OS-C102,	Structural Design of Offshore Ships
DNV-OS-C103,	Structural Design of Column Stabilised Units (LRFD-method)
DNV-OS-C104,	Structural Design of Self Elevating Units (LRFD-method)
DNV-OS-C502,	Offshore Concrete Structures
DNV-OS-E401,	Helicopter Decks
DNV-RP-H102,	Marine operations during Removal of Offshore Installations
DNV Classification	Note no. 30.4, Foundations
EN 1993-3	Design of steel structures – Part 3; Towers, masts and chimneys
IMO MODU Code,	Code for the construction and equipment of mobile offshore drilling units (MODU CODE)
ISO 19904-1,	Petroleum and natural gas industries – Floating offshore structures – Part 1: Monohulls, semi-submersibles and spars
Maritime Directorate's regulations,	Norwegian Maritime Directorate's regulation for Mobile Offshore Units, InfoMediaHuset, Oslo, 2003
NORSOK N-002,	Collection of metocean data
NORSOK S-001,	Technical safety
NORSOK U-001,	Subsea production systems
NS-EN 13670:2009	Execution of concrete structures – Common rules
+ NA:2010,	
NS 3481,	Soil investigations and geotechnical design for marine structures
PSA: The Framework Regulations,	Regulations relating to health, safety and the environment in the petroleum activities and at certain onshore facilities

NOTE The reference to DNV rules applies to the technical provisions therein. Any requirement therein for classification, certification or third party verification is not part of this NORSOK standard and may be considered as a separate service. Wherever the terms "agreement", "acceptance" or "consideration" etc. appear in the DNV rules they shall be taken to mean agreement, acceptance or consideration by the client/purchaser or any other specifically designated party. Likewise, any statement such as "to be submitted to DNV", shall be taken to mean "to be submitted to client /purchaser" or any other specifically designated party.

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1

action

external load applied to the structure (direct action) or an imposed deformation or acceleration (indirect action)

3.1.2

action effect

effect of actions on structural components

3.1.3

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.4

characteristic value

value of a basic variable, an action or a strength model having a prescribed probability of not being violated by unfavourable values

3.1.5**design premises**

set of project specific design data and functional requirements which are not specified or are left open in the general standard

3.1.6**design service life**

assumed period for which a structure or a structural component is to be used for its intended purpose with anticipated maintenance, but without substantial repair being necessary

NOTE On the NCS the design service life will be limited to the planned design service life in plan for development and operation and the DFI résumé as described in PSA: The Management Regulations..

3.1.7**design value**

value of a basic variable, action or strength model derived from a representative value for use in a design verification procedure

NOTE For a design check in accordance with the partial factor design format, a design value for a strength variable or model is found by dividing the representative value of strength by a partial resistance factor, and for an action variable by multiplying the representative value of the action effect by a partial action factor.

3.1.8**limit state**

state where a structure or part of a structure no longer meets the requirements laid down for its performance or operation

3.1.9**may**

verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.10**mobile offshore unit**

structure intended to perform a particular function at different locations

3.1.11**Norwegian petroleum activities**

petroleum activities where Norwegian regulations apply

3.1.12**operator**

company or an association that through the granting of a production licence is responsible for the day to day activities carried out in accordance with the licence

3.1.13**petroleum activities**

offshore drilling, production, treatment and storage of hydrocarbons

3.1.14**principal standard**

standard with higher priority than other similar standards

NOTE Similar standards may be used as supplements, but not as alternatives to the principal standard.

3.1.15**recognised classification society**

classification society with recognised and relevant competence and experience from the petroleum activities, and established rules and procedures for classification/certification of installations used in the petroleum activities

3.1.16**representative value**

value of a basic variable, action or strength model, for verification of a limit state

NOTE The representative value can be equal a characteristic value, a nominal value, or other rationally determined value.

3.1.17**resistance**

capacity of a structure, component or cross-section of a component to withstand action effects without exceeding a limit state

3.1.18**shall**

verbal form used to indicate requirements strictly to be followed in order to conform to this NORSOK standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.19**should**

verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred, but not necessarily required

3.1.20**verification**

examination to confirm that an activity, a product or a service is in accordance with specified requirements

3.1.21**warranty surveyor**

independent third party ensuring that the terms of the marine insurance warranty clauses are complied with

3.2 Abbreviations

ALS	accidental limit state
API	American Petroleum Institute
DFF	design fatigue factor
DFI	design, fabrication and installation
DNV	Det Norske Veritas
DP	dynamic positioning
EN	European Standard
FLS	fatigue limit state
FPSO	floating production, storage and offloading units
FSO	floating storage and offloading units
IMO	International Maritime Organisation
ISO	International Organisation for Standardisation
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee (in International Maritime Organization)
MODU	mobile offshore drilling unit
MPI	magnetic particle inspection
NCS	Norwegian Continental Shelf
NDE	non-destructive examination
NMD	Norwegian Maritime Directorate
NPD	Norwegian Petroleum Directorate
NS	Norsk Standard
PSA	Petroleum Safety Authority Norway ¹
SLS	serviceability limit state
ULS	ultimate limit state

¹ On 2004-01-01 the Petroleum Safety Authority Norway (PSA) was established as an independent, government supervisory body under the Ministry of Labour and Government Administration. The PSA will be the authority in charge of safety, emergency preparedness and working environment in the petroleum activities. The responsibility was taken over from the NPD.

4 General provisions and design principles

4.1 Regulations, standards and design premises

Load bearing structures used in the petroleum activities shall comply with relevant national and international regulations.

Action factors, material factors, DFFs and rules for combination of actions shall be determined on the basis of relevant national or international requirements with regard to reliability. When the rules of a classification society are used as basis for design and documentation, possible additional requirements necessary to fulfil relevant national regulations shall be identified and implemented. A class notation should be specified with the objective to minimise the need for additional requirements.

A design premises document shall be prepared and used as basis for design and documentation, stating all project specific regulations, standards, and functional requirements.

4.2 General requirements relating to personnel qualifications and organisation

General assumptions of this NORSOK standard are that

- personnel engaged in activities covered by the scope of this NORSOK standard (see clause 1) shall have the necessary qualifications and practical training,
- the organisation and the conduct of the engineering work shall be such that it will ensure that the work is carried out with safe and sound engineering judgement,
- the party carrying out the structural engineering have a person who is professionally responsible. This person shall have extensive experience in structural engineering and shall be given adequate opportunity to follow up the technical side of the work. The position for this person should be identified in the organization chart,
- the combined qualifications of the group of engineers performing the structural engineering are appropriate for the task,
- the time given for the work is not disproportional with the needs,
- the person who is professionally responsible and the personnel carrying out structural engineering and verification have adequate training and experience for their tasks. Documentation for the qualifications of personnel shall be available,
- structural engineers qualify the analysis by self-checking using simplified models and by alternative calculations of relevant structural parts where faults may entail major consequences. Documentation for these simplified calculations shall be available,
- the structural design, analyses and calculations are checked by other persons in the team with the appropriate competence and experience. Documentation for these checks shall be available.

In the guidelines for selection of materials and fabrication of structures, reference is made to recognized standards for personnel qualifications, e.g. NS-EN 13670:2009 + NA:2010 for personnel who will be carrying out and checking the execution of concrete work.

A number of maritime operations (e.g. anchoring, DP, crane operations, stability management and ballasting) require highly qualified and experienced personnel.

Special provisions

For special provisions relating to the Norwegian petroleum activities, see NMD: Regulations of 1 April 1996 No. 320.

4.3 Risk assessment

Risk assessments shall be carried out in order to identify accidental events that may occur in the activities, and the consequences of such events for people, for the environment and for assets and financial interests.