

Petroleum related manned underwater operations inshore

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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 Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.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.

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NORSOK standards are administered and published by Standards Norway.
This third edition replaces the second edition (March 2013).

With respect to the first edition (November 2010), 6.3.2 and 6.3.3 have been revised and Annex D has been added. Differences between second and third edition are only editorial.

Annex A and B are normative. Annex C and D are informative.

Introduction

This NORSOK standard is the result of an industry-wide effort to establish a standard for inshore petroleum related MUOs.

1 Scope

This NORSOK standard defines basic requirements for personnel, equipment and systems for petroleum related MUO (inclusive caisson) work inshore.

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.

2.1 Normative references

DNV OS-E402	DNV Offshore standard for diving systems
EN 15333-1	Respiratory equipment – Open-circuit umbilical supplied compressed gas diving apparatus – Part 1: Demand apparatus
EN 15333-2	Respiratory equipment – Open-circuit umbilical supplied compressed gas diving apparatus – Part 2: Free flow apparatus
IMCA 045	Code of practice for the safe use of electricity under water
ISO 6385	Ergonomic principles in design of work systems, (corresponds to NS EN 614-1 Maskinsikkerhet – Ergonomiske prinsipper for konstruksjon – Del 1: Terminologi og generelle prinsipper
ISO 8995	Lighting of indoor work places
Norwegian Oil and Gas – 002	Recommended guidelines for safety and emergency preparedness training
NORSOK S-006	HSE evaluation of contractors
NORSOK U-100	Manned underwater operations
NORSOK U-101	Diving respiratory equipment
NDTT	Norwegian Diving and Treatment Tables, ISBN:82-992411-3-8
NUI 2008-07	Nødluft i standard dykkehjelmer (Emergency air in heavy helmet)

2.2 Informative references

DMAC 11	Provision of first aid and the training of divers, supervisors and members of dive teams in first aid
IMCA D020	Scheme for recognition of diver medic training – Guidance for training establishments
NUI 2007-09	Støydempning i standard dykkehjelmer (Noise reduction in heavy helmet)
OGP 411	Diving recommended practice

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

can

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

3.1.2

caisson work

work operations where personnel are exposed to changes in ambient pressure, e.g. tunnel workers passing from one atmosphere to another

3.1.3

Contractor

company which carries out or arranges for the carrying out of MUO at inshore petroleum related plants and installations

3.1.4**diving basket**

part of the diving winch where the underwater worker(s) can stand/sit safely and in an ergonomically correct manner

3.1.5**diving winch**

appliance used to transport underwater worker(s) between the sea and the diving platform, as well as to stabilise underwater worker(s) during in-water decompression

NOTE The diving winch will normally consist of the following elements: diving basket, crane/lift unit, fastenings, wires, chain etc., and will be certified as one unit.

3.1.6**equivalent air depth****EAD**

depth at which air would provide the same nitrogen partial pressure as the actual nitrox mix at a given depth

3.1.7**free-flow helmet**

diving helmet where the breathing gas circulates freely in helmet and/or suit, and does not have any oral nasalmask

3.1.8**heavy free-flow helmet**

free-flow helmet connected to dry suit (e.g. Siebe Gorman and MarkV)

3.1.9**heavy helmet equipment**

complete personal diver equipment package including heavy free-flow helmet, dry suit, chest plate and heavy boots (also called "Standard gear", "John Brown rig" or "Hard-hat equipment")

3.1.10**inshore MUO**

MUO carried out inside territorial waters (normally within 12 n miles or 19,25 km from shore), including docks, harbours, canals, culverts, rivers, estuaries, lakes, reservoirs, dams, flooded tunnels, and tanks

3.1.11**light free-flow helmet**

free-flow helmet where there is no open connection to the suit where gas can move in or out

3.1.12**light MUO winch**

device for use in water only and which is not required to meet requirements/certification for personnel transport

3.1.13**manned underwater operation****MUO**

activity when humans stay below the surface and/or exposed to increased ambient pressure

3.1.14**may**

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

3.1.15**metre of sea water****msw**

pressure unit equal to 10 kPa (making 10 msw exactly 1 bar or 100 kPa), implies a relative density of 1,01972

3.1.16**nitrox**

a gas mixture of oxygen and nitrogen

3.1.17**non-compliance**

inadequate compliance with specified requirements

3.1.18**Operator**

oil company, responsible as the obligated party

3.1.19**petroleum related inshore MUO**

inshore MUO carried out in connection with petroleum installations, exploration and pipeline works

3.1.20**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

3.1.21**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

3.1.22**standby diver**

underwater worker who is dressed and ready to assist immediately in an emergency situation

3.1.23**surface oriented diving**

diving operation where the underwater worker enters and leaves the water at normal ambient pressure

3.1.24**transfer under pressure****TUP**

intervention method used in non-saturation diving shallower than 50 msw, where the underwater workers are transferred from their working depth to a surface decompression chamber in a closed bell maintaining pressure greater or equal to the first decompression stop

NOTE By removing in-water decompression-stops, surface intervals and re-compression, TUP is generally considered as a healthier, safer and more efficient alternative to other traditional surface supplied air/nitrox diving techniques (in-water decompression-stops and SD). The term TUP has different meaning in different contexts. Sometimes it is used for any process where underwater workers are kept at a pressure above the surrounding, while they move or are moved. In other cases the term is used to designate the facility that is used for the transfer, e.g. the bell or a special surface chamber used by the underwater workers passing from the bell to another chamber.

3.1.25**underwater worker (diver)**

person holding a diving certificate and a valid medical certificate issued by an approved authority or by institutions/organizations accredited by an approved authority

3.1.26**verification**

confirmation based on the examining and collecting of objective proof of compliance with specified requirements

3.2 Abbreviations

CE	Communauté Européenne
CO ₂	carbon dioxide
DNV	Det Norske Veritas (The Norwegian Veritas)
DP	dynamic positioning
EAD	equivalent air depth
EN	European Standard
HAZID	hazard identification
HAZOP	hazard and operability studies
HBO	hyperbaric oxygen
IMCA	The International Marine Contractors Association
ISO	International Organization for Standardization
kPa	kilopascal
msw	metre of sea water
MUO	manned underwater operation
NDTT	Norwegian diving and treatment tables
NUI	Norwegian Underwater Intervention AS
O ₂	oxygen
OGP	International Association of Oil & Gas Producers
OTU	O ₂ -tolerance unit
pCO ₂	partial pressure of CO ₂
pO ₂	partial pressure of O ₂
ROV	remotely operated vehicle
RUH	report on an undesirable incident
SJA	safe job analysis
SD	surface decompression
SDO ₂	SD using O ₂
SHE	safety, health and environment
STPD	standard temperature and pressure - dry
TUP	transfer under pressure

4 Administrative requirements

4.1 General

If there are safety aspects not covered in this NORSOK standard, an independent responsibility to maintain the safety level indicated by this NORSOK standard is imposed on anyone engaged in MUO.

Inshore MUO covered by this NORSOK standard is subject to the national authority requirements, statutes and regulations that apply in the area in which the MUO is to take place.

Contractor shall submit a compliance assessment, which identifies compliance and any non-compliances between the requirements of the local authorities and this NORSOK standard. Any non-compliances shall be dealt with in accordance with 4.3.

Contractor shall be qualified by Operator.

This NORSOK standard shall be included in all enquiries and contracts for inshore petroleum related MUOs.

NOTE Commercial pre-qualification entails registration in the Achilles database in accordance with the applicable requirements. The requirement for registration in Achilles applies to direct suppliers to Operator only and contracts valued at more than NOK 3,2 million.

4.2 Documentation

All documentation shall as a minimum satisfy the applicable national authority requirements.

Contractor shall describe all activities that are directly or indirectly involved in the work, either in the actual execution of the operation or in support of its safe and efficient performance. Examples of necessary supporting activities include

- a) risk analyses (HAZID, HAZOP, SJA etc.),

- b) health services (responsible diving doctor etc.),
- c) safety delegate service (established safety delegate organisation etc.),
- d) emergency response system (notification plans, drills etc.),
- e) system for planned maintenance,
- f) system for collecting and storing diver-exposure data,
- g) limits for monitoring parameters, including early warning, to be approved by Contractor's diving doctor.

4.3 Compliance, deviations and dispensations

Deviations and dispensations shall first be processed and approved internally by Contractor.

Contractor shall forward all non-compliances to Operator for acceptance. Only non-compliances accepted by Operator can be forwarded to the authorities as an application for exemption. Dispensations have to be granted by the parties involved, including representatives from the diving personnel, their safety delegates and the Operator. A risk analysis shall be performed.

4.4 Document availability

Contractor shall have a system that ensures that the applicable version of relevant documentation is available at the operation site, and that this documentation is continuously revised. The relevant documentation shall be reviewed by the diving superintendent, diving supervisor, diving doctor and the safety delegate. On request, Contractor shall also submit a copy of the documentation to Operator for consideration and acceptance.

Contractor shall inform Operator of all planned changes to diving-related documentation that take place during the contract period. Operator shall accept the changes prior to their implementation.

Contractor shall present

- a) a compliance matrix based on this NORSOK standard and relevant regulations, in accordance with UCM-31 of Annex A,
- b) a plan for the handling of any non-compliances through implementing corrective actions or alternative solutions (alternative solutions shall be based on documented analyses covering all relevant aspects),
- c) a description of the diving methods planned to be used during the operation,
- d) assessment of whether saturation diving and/or TUP could be applied if the MUO lasts for more than one month with depth continuously exceeding 25 msw,
- e) outline of Contractor's applicable document structure,
- f) a plan describing the internal auditory activities intended to ensure that legal and contractual requirements are met.

4.5 Reporting and notification

4.5.1 Operational reporting

4.5.1.1 Daily report

Copies of all logs and reports shall be made available to Operator's representative on request.

4.5.1.2 Weekly report

Contractor shall send Operator weekly statistics of the previous week's and the project's accumulated data in accordance with URF-31 of Annex A.

4.5.1.3 Experience report

If Contractor have had contract with Operator during the calendar year he shall within January 31st following year, submit to Operator an experience report, see URF-32 of Annex A. For projects with duration more than 14 working days, Contractor shall additionally within three weeks after completion of work, submit to Operator an experience report for the actual project, also according to URF-32 of Annex A.

These reports shall be prepared in cooperation with the safety delegate and Contractor's diving doctor. Relevant matters and factors relating to safety, occupational hygiene, equipment and operational experience shall be assessed and included.

4.5.2 Reporting of accidents, near-misses, non-compliances, failures and damage/injury

Contractor shall have a reporting system that ensures that all undesirable incidents such as accidents, near-misses, quality non-compliances, material damage and equipment failure etc. are reported, registered and dealt with by Contractor.

4.5.3 Notification

Operator shall be notified immediately of any serious injuries to personnel and any serious near misses. For all other injuries and near misses Operator shall be informed as soon as possible and always within 12 h. For MUO related incidents notification shall also be given through the emergency response line. Operator shall also be given copies of all reports from Contractor to the authorities.

5 Safety, health and environment (SHE) requirements

5.1 General

Data and statistics relating to SHE shall be used systematically to achieve continuous improvement of the planning and performance of the operations covered by this NORSOK standard.

Contractor shall meet the SHE requirements set out in NORSOK S-006. Noise level shall be as required in relevant parts of NORSOK U-100, 5.2.2.6, and for the breathing gas generated ("self-induced") noise EN 15333-2, 5.20.

5.2 Diving doctor

Contractor's organization shall include a qualified doctor specialized in diving medicine. The diving doctor shall give advice in matters of ergonomics, physiology, medicine and hygiene relevant for underwater workers' health and safety. The doctor shall approve the health-related aspects of Contractor's MUO manual.

There shall be a job description for the doctor.

5.3 First aid

Contractor shall have first aid equipment minimum to the specifications given in Annex B. There shall be sufficient O₂ for treatment of an ill or injured underwater worker until public health service can take over the responsibility. First aid equipment shall be approved by Operator's diving doctor.

5.4 Threshold values for pO₂ and O₂ exposure

Threshold values for pO₂ and O₂ exposure given in NDTT shall be adhered to. See Annex C for examples of calculation.

6 Personnel and crew requirements

6.1 General

All personnel directly or indirectly involved in a MUO shall be familiar with the applicable operation procedures, emergency procedures, emergency response plans, reporting routines, RUH etc. that are relevant to the function of the person in question, and be trained and certified in accordance with recognised norms where such exist.

Contractor shall document that the personnel are familiar with the emergency procedures prior to start of MUO.

6.2 Familiarisation

Contractor shall have a system to ensure that personnel participating in operations have been given adequate training before actively participating in the operation.

Familiarisation shall be carried out in accordance with a pre-planned programme and it shall be possible to document it. The programme shall include operation of chamber.

6.3 Requirements for personnel

6.3.1 Diving superintendent

This position is required under the conditions described in 6.6. The diving superintendent shall as a minimum be a qualified diving supervisor.

6.3.2 Diving supervisor

Every MUO shall be led by a diving supervisor positioned at the surface. The diving supervisor shall be appointed by Contractor in writing and have the following qualifications:

- a) comply with the requirements for an assistant diving supervisor (6.3.3);
- b) have at least one work year of practical experience as an assistant diving supervisor. At least 200 h of this practical experience shall have been served at a diving control panel;
- c) have carried out at least 200 commercial dives;
- d) have completed advanced first aid training (ref. Annex D), and have received management training;
- e) have passed the examination for diving supervisors;
- f) thorough knowledge of the work tasks to be carried out.

6.3.3 Assistant diving supervisor

A dive team shall also include an assistant diving supervisor. The assistant supervisor shall have the following qualifications:

- a) be a qualified surface oriented diver (renewal of certificate of medical fitness for divers, is not required);
- b) be at least 24 years of age;
- c) have at least two years practical experience as a commercial diver and have carried out at least 100 commercial dives;
- d) have undergone a training course at a qualified institution and have completed the final examination for assistant diving supervisors;
- e) introductory DP-course and minimum 25 commercial dives from a DP vessel, if a DP vessel is directly engaged in the dive operation;
- f) thorough knowledge of Operator's requirements and Contractor's procedures, equipment and routines.

6.3.4 Underwater workers (divers)

Underwater workers shall have an approved diving certificate and a valid medical certificate appropriate to the nature of the work and the equipment being used.

When special tasks require special training, the qualifications of the underwater worker shall be documented.

6.3.5 Standby diver

The standby diver shall have the same qualifications as underwater workers and be familiar with the relevant rescue techniques.

6.3.6 Technical personnel

Personnel carrying out maintenance of diving systems and equipment shall have documented, relevant training for the tasks to be performed.

6.3.7 Diving assistant

The diving assistant shall have the minimum theoretical knowledge required for an underwater worker and be able to

- a) run the dive,
- b) help the underwater worker with tools and equipment,
- c) see that the safety of the underwater worker is well maintained,
- d) run a SD,
- e) initiate treatment of underwater worker in agreement with medical doctor.