

# NORSOK Standard

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## Drilling facilities

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## Drilling facilities

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## Foreword

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and eliminate unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and supported by the Norwegian Oil and Gas Association and the Federation of Norwegian Industries. NORSOK standards are administered and issued by SN (Standards Norway).

The purpose of NORSOK standards is to contribute to meet the NORSOK goals, e.g. by replacing individual oil company specifications and other industry guidelines and documents for use in existing and future petroleum industry developments.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of a NORSOK standard will be used to provide input to the international standardisation process. Subject to implementation into international standards, the NORSOK standard will be withdrawn.

Annex A and C is informative and B is normative.

## Introduction

The main objective of this NORSOK standard is to contribute to an optimization of the design of drilling facilities, including systems and equipment with respect to utilization, operational efficiency, life cycle cost and to promote sound HSE principles.

The standard can be utilized for modification of drilling facilities where only modified part need to be in compliance with this standard.

The standard may also be utilized for modular drilling facilities, work-over and P&A rigs. In this case the datasheet in Annex C shall be adapted to fulfil the specific requirements.

### Note:

Correction of a misprint has been corrected in sub clause 6.35.1. 2013-01-10

## 1 Scope

This standard describes the functional requirements, design outline, installation and testing requirements for the drilling facilities and their systems and equipment on fixed installations and mobile offshore drilling units (MODUs).

Functional requirements will normally be based on:

Area of operation:

- Skagerrak and North Sea;
- the Norwegian Sea;
- Barents Sea, south of 72°N;
- Barents Sea, north of 72°N.

Area of utilization:

- drilling facility for fixed installations operating in one field during lifetime;
- modular drilling rigs;
- MODUs.

Planned well operations:

- drilling wells;
- completion;
- well work-over;
- well interventions;
- well abandonment operations;
- 3rd party equipment and operations;
- simultaneous operations.

Environmental issues:

- amount of waste from drilling area;
- possibility to handle waste;
- drain systems.

Maintainability:

- online support;
- replacement of 3rd party equipment;
- access;
- back-up.

Interfaces:

- interface towards facility/unit equipment and systems;
- interface to 3rd party equipment.

The design outline is meant to encourage:

- safe design and lay-out;
- robust and efficient facilities/systems;
- separation of various areas and systems/equipment;
- working environment.

Design of facility require:

- verified layout by design review;
- all relevant operation conditions/situations included;
- interface between all relevant functions with adequate capacity included.

Minimum testing requirements are:

- factory acceptance test (FAT);
- commissioning test;
- acceptance / integration test based on complete verification of equipment and systems/sub systems as operated under normal conditions.

## 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

ANSI B 31.3, *Process Piping*

API RP 14C, *Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms*

API RP 2R, *Marine Riser*

API Spec 4F, *Drilling and Well Servicing Structures*

API Spec 7, *Rotary Drilling Equipment (replace with ISO 10424 when issued)*

API Spec 9A, *Specification for Wire Rope*

API RP 13C, *ISO 13501 (modified), Recommended Practice on Drilling Fluids Processing Equipment Evaluation*

API Spec 6A, *Specification for Wellhead and Christmas Tree Equipment*

API Spec 16C, *Choke and Kill System*

API Spec 16D, *Specification for Control Systems for Drilling Well Control Equipment*

API RP 16E, *Recommended Practice for Design of Control Systems for Drilling Well Control Equipment*

ANSI/API 16J, *Comparison of Marine Drilling Riser Analyses*

API Standard 53, *Blowout Prevention Equipment Systems for Drilling Wells*

ASME VIII, *Div. 1 and Div. 2, Pressure Vessel Code*

EN 13445, *Unfired pressure vessels – All parts*

ISO 12100 *Safety of machinery -- General principles for design -- Risk assessment and risk reduction*

ISO 80000, *Quantities and units – All parts*

ISO 13533, *Petroleum and natural gas industries – Drilling and production equipment -- Drill-through*

ISO 13535, *Petroleum and natural gas industries – Drilling and production equipment – Hoisting equipment*

ISO 13624, *Petroleum and natural gas industries – Drilling and production equipment – All parts*

ISO 15663-1, *Petroleum and natural gas industries – Life cycling costing – Part 1: Methodology*

ISO 15663-2, *Petroleum and natural gas industries – Life-cycling costing – Part 2: Guidance on application of methodology and calculation methods*

ISO 15663-3, *Petroleum and natural gas industries – Life cycling costing – Part 3: Implementation guidelines*

ISO 10423, *Petroleum and natural gas industries – Drilling and production equipment – Wellhead and christmas tree equipment*

NACE MR-0175, *For sour service*

NORSOK D SR 007, *Well testing system*

NORSOK D-010, *Well integrity in drilling and well operations*

NORSOK I-001, *Field instrumentation*

NORSOK L-001, *Piping and Valves*

NORSOK M-001, *Materials selection*

NORSOK P-001, *Process design*

NORSOK R-002, *Lifting equipment*

NORSOK R-003, *Annex J, definition of lifting equipment in drilling*

NORSOK S-001, *Technical safety*

NORSOK S-002, *Working environment*

NORSOK S-003, *Environmental care*

NORSOK S-005, *Machinery – working environment analyses and documentation*

NORSOK Z-015, *Temporary equipment (Rev. 4, Sept. 2012)*

NORSOK Z-DP-002, *Coding systems*

NORSOK C-002, *Architectural components and equipment*

NS 5820, *Suppliers documentation of equipment*

NWEA Guidelines, *NWEA Guidelines For The Safe Management of Offshore Supply And Anchor Handling Operations*

Norsk olje og gass 070, *Guidelines for the Application of IEC 61508 and IEC 61511 in the petroleum activities on the continental*

Norsk olje og gass 081, *Anbefalte retningslinjer for fjernoperert rørhåndtering NY REVISJON pr 11.06.12*

YA 711, *Principles for alarm system design. (Norwegian Petroleum Directorate)*

## 2.2 Informative references

None.

## 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 competent person

as defined in the EC Directives for Supply of Machinery

#### 3.1.2 drilling facilities

structures containing systems, equipment and utilities required for drilling operations

### 3.2 Abbreviations

|      |                                         |
|------|-----------------------------------------|
| ACS  | anti-collision (zone management) system |
| AWD  | analysis while drilling                 |
| BHA  | bottom hole assembly                    |
| BOP  | blow-out preventer.                     |
| CCTV | closed circuit television               |
| CT   | coiled tubing                           |
| DAT  | direct acting tensioners                |

|       |                                              |
|-------|----------------------------------------------|
| DCDA  | drilling control and data acquisition system |
| DCS   | drilling control system                      |
| DSM   | drilling support module                      |
| DES   | drilling equipment structure                 |
| EDS   | emergency disconnect sequenced systems       |
| ESD   | emergency shutdown system                    |
| FAT   | factory acceptance test                      |
| HP/HT | high pressure/high temperature               |
| HVAC  | heating, ventilation and air conditioning    |
| I/O   | input/output                                 |
| KEMS  | kinetic energy measuring system              |
| LER   | local equipment room                         |
| LIR   | local instrument room                        |
| LMRP  | lower marine riser package                   |
| MEWHP | maximum expected wellhead pressure           |
| MGS   | mud/gas separator                            |
| ML    | mud logging                                  |
| MODU  | mobile offshore drilling unit*               |
| MPD   | managed pressure drilling                    |
| MSL   | mean sea level                               |
| MTBF  | mean time between failure                    |
| MTTR  | mean time to repair                          |
| MWD   | measurement while drilling                   |
| NWEA  | North West European Area                     |
| NACE  | National Association of Corrosion Engineers  |
| OEM   | original equipment manufacturer              |
| P&A   | plug and abandon                             |
| PL    | point load                                   |
| PLC   | programmable logic controller                |
| PV    | pressure vessel                              |
| RARS  | riser anti-recoil system                     |
| RPM   | revolutions per minute                       |
| RWP   | rated working pressure                       |
| SG    | specific gravity                             |
| SI    | Système International d'Unités               |
| UBD   | underbalanced drilling                       |
| UDL   | uniform distributed load                     |
| VDU   | visual display unit                          |
| VPH   | vertical pipe handling                       |
| WCI   | wind shield index                            |

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\* Requirements for MODU will also be applicable for floating production and drilling units

## 4 Deviations

The facility owner is responsible for any deviations from this NORSOK standard. The deviation process shall be in accordance with owner's approved system for handling deviations.

## 5 General requirements

### 5.1 Common requirements

The drilling facilities shall be designed, built and equipped in compliance with applicable regulations, this standard and other industry recognised standards such as those from API, ANSI, ASME, BS, ISO, NACE, NORSOK and TBK referenced in clause 2 above. Materials shall be selected according to NORSOK M 001 and piping and valves according to NORSOK L 001.

Any modular or none standard rig not built to a specific facility shall be subject to studies with regards to HSE requirements, layout, interfaces and well parameters at the actual location for use.

The drilling facilities shall be designed to allow for easy and safe operation and maintenance, with adequate manning levels.

Environmental friendly fluid shall be used to the extent possible where there is a risk of spill to sea.

### 5.2 Design outline

An overall objective is that the design shall ensure that no single failure in drilling and well activities shall entail any life threatening situation for the involved personnel, or significant damage to material and the environment. This applies both to operational errors and to failure in connection with equipment used directly in operations, as well as equipment with auxiliary functions.

The operational objectives will constitute the basis for definition and revision of the acceptance criteria for risk in connection with drilling and well activities, and for the choice of risk reducing measures.

System and equipment shall be protected against potential excessive loads and pressure. Control system for vital well and safety functions shall in addition be protected against potential damage, fire and explosions.

Safety systems are to provide two independent levels of protection to prevent or minimise the effects of a single malfunction or fault in the process equipment and piping system, including their controls. The two levels of protection are to be provided by functionally different types of safety devices to reduce the probability for common cause failures.

All equipment shall be located to ensure safe operation and, if located in hazardous areas, shall be suitably protected for installation in such areas.

The facilities shall be designed to minimise risks of personnel injuries, environmental hazards and economic loss.

A full operability study shall be carried out based on all activities planned for. Pipe and material handling shall be evaluated for drilling equipment structure (DES) in all well slot positions.

Typical drilling/completion program may be utilized as supporting document. OLF 081 shall be utilized for pipe handling study. Studies with regards to change of equipment, additional equipment and refurbishment shall include all adjacent areas that may affect the functionality.

### 5.3 Life cycle cost and regularity

Regularity requirements and selection of equipment shall be defined prior to detailed design, based on availability (MTBF/MTTR), service intervals and life cycle cost. The service activities shall not interfere with the drilling activities. The service intervals shall reflect the MTBF.

## 5.4 Process and ambient conditions

The drilling facilities shall be selected/designed to operate under ambient conditions prevalent in the intended area of operation.

- Ambient conditions for structure and machinery shall be based on relevant metocean data.
- Operation under cold climatic conditions requires special attention with regards to ambient conditions (icing, WCI, etc.).
- Modular rigs shall be compatible with characteristics for platform/vessel.
- Facilities for deep water and/or HP/HT wells shall be designed for such services.

## 5.5 Testing requirements

The various vendors shall present a test procedure, including acceptance criteria, prior to the FAT for their equipment, system or sub-system. Mechanical completion shall be completed prior to testing. The commissioning procedures shall describe all tests to be carried out during the platform commissioning and start-up phase for the equipment as a stand-alone unit. The procedure context may be reviewed and approved by the owner/user of the systems.

The drilling package shall be tested and accepted as a complete system, with all subsystems integrated. Loads and I/O shall be simulated and recorded if a full scale test is not possible.

A complete integration test of the drilling package is recommended to reveal any showstoppers or bottlenecks in any of the systems working together

During platform commissioning and start-up, the various drilling systems including instruments shall be utilised to verify the sensor data.

## 5.6 Simultaneous operations

It shall be possible to perform overhaul and maintenance work and testing of BOPs and x-mas trees on test stumps while normal drill floor operations are on-going.

The design shall allow for optimum simultaneous drilling, production, maintenance and well intervention operations where applicable.

If simultaneous drilling and well intervention are required in area covered by the drill floor envelope and access is not obtained through conventional well bay design, an alternative base design shall be used.

For drilling facilities with dual derrick design, the design, layout and equipment shall allow for preparation as well as for optimum simultaneous drilling, well maintenance and well intervention operations.

## 5.7 Layout requirements

### 5.7.1 General

The layout of systems, equipment and operating/control stations, lay down and store areas shall be based on the thorough design review, risk analysis, operability studies in combination with proven oilfield experience.

Interfaces to other part of the facility, e.g. topside shall be arranged for in the early engineering phase.

All work areas in connection with drilling activities shall be arranged to ensure the safety of personnel and operations, working environment and pollution control.

The layout of the drilling facilities shall give due consideration to areas that may be exposed to dropped objects, especially in connection with maintenance and material and equipment handling.

Areas that shall be unmanned during various operations shall be defined early in the project. It shall be possible to move to/from the various operator stations during operation.

The layout shall ensure that maintenance and service can be carried out in a safe and ergonomically efficient way.

### 5.7.2 Material handling

The layout and design of the drilling facilities shall enable safe and efficient transport, handling and storage of materials and tubular. A material handling and storage study shall be performed. For pipe handling reference is made to 5.2.

An operability study based on all activities planned shall be carried out early in the project typically including

- receiving equipment on-board,
- skidding,
- hook-up 3rd party equipment,
- swarf handling,
- cuttings handling,
- slurry injection,
- wire line operation,
- coiled tubing operation,
- snubbing operation,
- MPD/UBD,
- building BHA drill string,
- running BOP and riser,
- drilling,
- running casing,
- cementing,
- completion,
- well intervention,
- down hole control lines,
- down hole cables,
- slip ring handling.

### 5.7.3 Workshops, stores, offices and services

Workshops for welders, electricians, instrument engineers, hydraulic engineers and mechanics with necessary equipment shall be available, and be located in areas with relevant classifications. For fixed installations the workshops should be considered to be part of the platform facilities (i.e. share the use of platform workshops).

There shall be sufficient dry and heated stores for drilling equipment, in-hole equipment and spare parts as well as lifting appliance etc. Relevant transportation/handling facilities shall be provided.

The drilling offices shall have easy access to all areas of the drilling facilities, especially the drill floor.

A study with regards to need of offices and work stations shall be carried out in the early engineering phase.

AWD equipment/workstation shall be located close to the drill floor and mud treatment plant, or there shall be utilities for sending signals onshore to drilling centre as specified by operator.

A mud laboratory including a workbench or desk and cabinet for storage of chemicals with adequate extraction/HVAC shall be located close to the mud pits, and be connected to the required utility systems including drains.

### 5.7.4 Completions and intervention equipment

Sufficient space shall be provided for equipment and operations for completion and intervention equipment such as slick and braided wire line, electric logging, coiled tubing, snubbing, well completion, work over and well testing.

All necessary utilities with adequate capacity shall be available close to the specific equipment, including necessary safety systems and temporary communications equipment.

## 5.8 Drilling power systems

The drilling power system integrity shall be based on risk assessment and ensure that systems or part of systems are available to handle any unforeseen well control situations. A defined shutdown philosophy shall be established.

Drilling electric power should comprise of the following systems:

- main power for all drilling systems;
- power for essential drilling operations (upon loss of main power);
- emergency power;
- UPS for low voltage emergency consumers and instrument monitoring and control systems;
- normal lighting and small power system;
- emergency lighting and small power system.

## 5.9 Emergency power

It shall be identified which systems and consumers that requires supply directly from an emergency power system.

Typical consumers will be

- electric pump for well control equipment/system,
- pump(s) for circulating drilling fluid at identified rate,
- transfer pump(s) for drilling fluid,
- 1 x 100 % HVAC for safety critical non-hazardous rooms as LER/LIR, switchgear room and driller's cabin,
- emergency lighting and small power,
- other consumers as listed in NORSOK S-001.

## 5.10 Essential power

It shall be possible to supply essential drilling consumers from an additional power source in case of main power failure, either from an essential generator or an emergency generator. The power shall be sufficient to facilitate the following operations, not simultaneously but in relevant combinations:

- mix and transfer drilling fluid;
- circulate drilling fluid at identified rate;
- complete on-going cement job;
- limited main hoisting operation;
- rotate drill string at limited RPM/torque;
- operation of selected pipe handling equipment at limited speed.

It shall not be possible to connect alternative power supply in case the local equipment room is shut down due to gas, smoke or fire.

It shall be possible to manually activate the alternative power for essential consumers within 30 minutes.

## 5.11 UPS Power

The following systems shall be powered by UPS supply and be suitable for zone 1 operation (Ex/ATEX certified) for all components:

- well control system;
- consumers listed in NORSOK S-001;
- other critical systems/functions identified critical during shutdown.

The following systems should also be powered from UPS available to the point where non EX equipment/LIR has to be isolated:

- servers;
- controllers (PLCs);
- monitors;
- networks components.

## 6 Drilling systems

The drilling systems covers the various systems required for a drilling unit facility, including the functional requirements for the relevant system. If there are any installation specific special requirements, these are described under a separate chapter, per system.

### 6.1 General

Some of the systems hereunder described may be spread over more than one area, e.g. high pressure mud system will occur in DES and Drilling Support Module (DSM).

### 6.2 Drilling equipment structure

The drilling equipment structure (DES) describes the requirements for the structures comprising the drilling unit.

#### 6.2.1 General

The drilling equipment structure (DES) consists of substructure, drill floor, derrick/hoisting structure, mast, access ladders, walkways, work platforms and associated equipment within the area.

#### 6.2.2 Functional requirements

The system shall be designed to and capable of handling tubulars and heavy well control equipment such as, but not limited to, in an efficient way:

- drill strings;
- casing strings;
- conductors;
- risers and associated equipment;
- BOP stacks and x-mas trees;
- equipment for MPD and/or UBD if specified.

The system design shall allow for performing wire line work, electric logging, coiled tubing and snubbing unit operations from the drill floor, considering space, height, equipment handling and access to the equipment and weather protection.

Additional space and utilities for special drilling operations such as MPD/UBD should be considered.

Access in connection with operation and maintenance of equipment shall be catered for by suitable and safe access from deck or installed work/access platforms.

#### 6.2.3 Special requirements for fixed drilling installations

The DES shall be capable of skidding between well slots with full setback with drill pipe and drill collars alternative stored string of casing, unless otherwise specified.

Drag chain shall be used for hoses and cables. Bending radius shall not exceed minimum requirement for any cables or hoses.

The DES shall be designed to withstand ambient conditions for planned area of operation and withstand unlimited operations with regards to hook load, setback load, and rotary load for wind speed up to 30 m/s, 10 minutes mean 10 metres above MSL unless otherwise specified. Earthquake conditions and platform accelerations shall be considered where applicable.

## 6.2.4 Special requirements for MODU

Storage for risers (drilling, work over) and slip joint in use shall be provided, including service area for same.

A handling system shall be available for marine risers (slick joints and joints with flotation), work over riser, slip joint, riser pup joints and riser accessories.

## 6.3 Derrick/mast

The derrick/mast provides the in height structure required to be able to run and pull tubulars in and out of the well and also to handle equipment over the well centre.

### 6.3.1 General

The derrick/mast or hoisting structure shall be designed to withstand the forces imposed by installed equipment, operational loads and adequate environmental conditions.

### 6.3.2 Functional requirements

Access in connection with operation, maintenance and inspection of equipment shall be catered for by suitable and safe access from deck or installed work platforms. In addition there shall be access and facilities provided for change out of heavy equipment.

Work platforms in derricks shall be adequately equipped with hand rails and safety devices, lift, stairs or ladders for safe access.

Lubrication points with difficult access such as sheaves etc. shall be routed to an easy accessible area.

It shall be provided sufficient number of hang off points of required capacity underneath water table or similar platform for hang off line(s) for travelling assembly, manual rig tongs, winches, wire line, umbilical sheaves and tubing/cable for completion. All hang off points shall be certified.

A study based on planned operational requirements and load applied by rented equipment such as wire line unit etc. shall be carried out to decide number, size and capacity of hang off points.

Dedicated cabinet for tools, safety harness, lubricants etc. shall be located as required for work in height.

## 6.4 Drill floor

The drill floor provides the main work area to enable the execution of the drilling operations.

### 6.4.1 General

The drill floor shall in relevant areas be designed for dropped objects protection, i.e. to withstand the impact from a falling 9 1/2" drill collar stand from a height of 1,5 m. Mouse hole shall be designed to withstand maximum impact load based on type of tubular.

A dropped object study shall be performed to verify that manned areas such as driller's cabin can withstand the impact of any falling objects with regards to pipe and material handling.

Restricted areas (red zone) shall be defined early in the project

Access to operator stations such as driller's cabin, winch control panels and others shall be available without crossing "red marked" areas.

The outline of drill floor shall take into consideration space for all planned operations including well intervention and completion operation (spools for tubing/wire).

Elevation of drill floor shall be taken into consideration with regards to material handling

Noisy equipment such as draw work shall be installed in an area not manned during normal operation e.g. on a mezzanine above rig floor or similar.

Work areas within drill floor shall be covered with non-skid material.

The setback area shall be covered with a material which prevents tool joint damage.

A heavy tool store with designated lay down area for crane handling shall be provided. Efficient and safe handling of tools between the tool store and the drill floor including the well centre shall be given due consideration. Material handling to/from landing shall be arranged without entering the red zone.

Drilling subs and inside drill pipe BOP etc. to be stored easy accessible in dedicated sub racks at the drill floor.

Drill floor shall have capacity to store the complete drill string during casing and completion work if nothing else is specified by operator.

Optional casing racking capacity should be considered by owner.

## **6.5 Substructure**

The substructure is the foundation for the drill floor and provides also the elevation required to handle and install equipment on the wellhead.

### **6.5.1 General**

The substructure shall be designed to form an adequate foundation for the derrick/mast or hoisting structure and the drill floor, and provide required elevations and handling space as applicable.

The substructure shall be designed to withstand all combined loads from derrick/mast or hoisting structure and drill floor with full loadings as specified above, BOP handling loads, as well as equipment installed in the substructure itself.

Elevation of substructure shall allow for gravity return of drilling fluid from overflow process tanks back to mud pits.

Necessary additional elevation/space for MPD equipment shall be taken into consideration.

Access platforms or work basket shall be available for maintenance of equipment.

## **6.6 Hoisting and rotary systems**

Hoisting and rotary systems provides the means to hoist, lower and rotate tubulars and tools in the well, and also to install equipment in the well and on the wellhead.

The systems shall be designed to handle the BOP stack, diverter, drill strings, casing, liners and tubing as well as x-mas trees and completion equipment. For MODU's it shall be able to handle Subsea BOP stack and marine risers as well as subsea x-mas trees and completion equipment.

### **6.6.1 General**

This sub clause describes the requirements to hoisting and rotary systems including equipment such as:

- draw work/hoisting system;
- crown block/drill string compensator/structural parts of compensators;
- travelling block/yoke;
- drilling hook/adaptor;
- top drive;
- guide dollies;
- drill line spool and anchor;
- rotary table.

### **6.6.2 Functional requirements**

The draw work/hoisting system shall be equipped with an emergency stop device which in the event of main brake/hydraulic/electrical system failure shall have the capability to stop the movement. The emergency stop device shall be readily identified and easily accessible.

Kinetic energy and travelling assembly monitoring as well as crown- and floor saver shall be provided.

It shall be possible to lower the load in case of failure in control system or loss of power. One brake system shall be dedicated for emergency/park function.

Drill line spool shall have mechanical drive device.

Deadline anchor shall be of rotating type.

It shall be possible to suspend the travelling assembly independent of the hoisting system. Safe access for slip and cut of the drill line shall be provided.

The top drive shall be fitted with a removable plug on top for wire-line work through the opening. A suitable and pressure tested wire line lubricator for such work to be available on-board. This will also apply for travelling yoke for cylinder rigs.

It shall be possible to rotate and lock the rotary table from the driller's cabin. Rotary table shall be operated independent with regards to the top drive.

Bushings shall facilitate space for down-hole control lines, wire line and control umbilical's when running drill and tubing string if relevant for well completion and testing.

### 6.6.3 Special requirements for MODU

Rotary table opening consideration shall be addressed relevant to such as marine riser size, completion, subsea equipment and MPD equipment etc. Drive rings and bushings shall be of split type.

## 6.7 Motion compensating and tensioning systems

The motion compensating and tensioning equipment are specific for floating installations and provide means to compensate for the installation's vertical and horizontal movements induced by wave and wind forces and to maintain constant tension on equipment and tools with a fixed connection to the sea-bed or in the well.

### 6.7.1 General

This paragraph describes the overall requirements for motion compensating and tensioning equipment and systems

The systems may include:

- marine riser tensioners (incl. direct acting tensioner/in-line tensioner);
- surface BOP/riser tensioner;
- guideline tensioners;
- pod line tensioners;
- idler sheaves (where applicable);
- drill string compensator, active and passive;
- active heave compensating draw works;
- surface test tree frames build-in compensator;
- pressure vessels;
- control panels;
- high pressure compressors or hydraulic power packs.

### 6.7.2 Functional requirements

#### 6.7.2.1 Jack-up conductor/riser tensioner

Surface conductor and riser tensioners are required on jack-up rigs when drilling in free standing mode and on subsea template. The tensioner shall have individual hydraulic supply. The system shall maintain required tension with failure on one of the cylinders.

#### 6.7.2.2 Marine riser tensioner

Marine riser tensioners shall be designed to have a combined tension capability to keep the specified riser length for the rigs specified water depth, filled with mud specified to project density requirements in tension, and with enough over-pull to lift the riser and the LMRP with sufficient speed in the event of an emergency unlatch situation.

Required number of tensioners and combined tensioner force is subject to actual MODUs water depth capability, and defined in each case.

Two types of marine riser tensioners are commonly used on MODUs:

1. The wire line tensioners with cylinders/pistons, sheaves and ropes attached to and acting on a support ring fitted on the riser slip joint.
2. Direct acting tensioners (DAT) or in-line tensioner with cylinders/pistons suspended in the drill floor structure are attached to and acting directly on the support ring fitted on the riser slip joint.

The tensioners should be installed in pairs acting opposite to each other and are connected to a high pressure accumulator bank

The number of PVs, and the flow area of piping shall be sufficient to where the tensioning activity can take place at a rate corresponding to the MODUs motion characteristics, and without a detrimental tension load fluctuation.

It shall be possible to isolate part of the PVs as well as controlling the pressure to adjust number of vessels and the operating pressure with regards to compensation tension variation.

All PVs and pressure containing parts that can be closed off shall be protected by pressure safety relieve valve venting to atmosphere with one exception. The rod side of the tensioning cylinder is protected by a relief valve function in the shut-off valve and if over pressurized, it shall vent back to the accumulator.

The riser tensioner systems shall be designed with a riser anti-recoil system (RARS) that is controlling the upward movement of the tensioner's pistons to a pre-set speed depending of operation and possible system and riser failure.

A proportionally shut off valve shall be installed in the piping between each cylinder and the accumulator bank. The valve together with a piston measuring system for speed and position and a programmable control system are the main components of the RARS.

The RARS shall gradually shuts off the hydraulic supply to the cylinders and thereby reduce the retraction speed in the event of LMRP disconnect, riser, tension wire or cylinder failure to eliminate or minimize the effect of riser recoil.

An alarm system indicating any malfunction to the driller shall be part of the riser tensioning system.

#### **6.7.2.3 Guideline and pod line tensioner**

4 each guideline tensioners and 2 each pod line tensioners are normally required unless BOP is of guideline less design.

Applied tension forces should act symmetrically around the well centre.

#### **6.7.2.4 Drill string compensator (DSC)**

Drill string compensator shall be passive with active compensating mode design.

Compensating type draw work may be used.

It should be possible to compensate the subsea BOP stack heave motion at 0,9 m/s peak speed.

The compensating system shall be design such that no un-intentional locking occurs.

It shall be possible to isolate part of the PVs from the driller's position to facilitate smooth operation with regards to controlling low weight on the string (for example setting of wear bushing and seal assembly).

### **6.8 Pipe handling systems**

The pipe handling systems provide the means to handle tubulars and drilling tools from storage to vertical over the well centre by means of manipulator tools, to minimize the requirement for manual handling.

### 6.8.1 General

The pipe handling systems include:

- vertical pipe handling systems;
- horizontal pipe handling system;
- horizontal to vertical pipe handling system;
- finger board;
- belly board;
- mouse hole.

All necessary equipment for manual pipe handling shall be included.

### 6.8.2 Functional requirements

The pipe handling shall be remotely operated and fulfil the requirements as described in OLF 081. Areas with no admittance during normal operation shall be mapped out in the design outline and location of operator stations placed accordingly.

It shall be possible to move pipe handling equipment to a safe position in case of failure and continue operation to the degree that is possible manually. It shall be possible to lower top drive and secure well.

System for transporting pipe between pipe deck and rig floor (conveyor or similar) shall have additional feasibility to transport risers, drill bits, x-overs, subs and other down hole equipment as described in OLF 081.

## 6.9 Driller's cabin

The driller's cabin is the driller's work place, from which he is controlling the drilling and safety systems required to execute the drilling and well operations.

### 6.9.1 General

The driller's cabin shall have necessary space and of ergonomic design to full fill requirements to working environment, safe operation and escape way leading to safe area.

Operators view to drill floor, derrick, hoisting structure, mast and V-door shall be without obstructions. Cameras with monitors can be used as compensating measure for the derrick, pipe handling equipment and mast if necessary.

2 x 100 % HVAC shall be utilized if pressurized safe equipment in cabin is chosen.

Control panels shall be easily accessible. Monitors shall be easy to read without disturbing the view out of cabin.

### 6.9.2 Functional Requirements

The driller's cabin shall include the number of workstations as required to operate equipment. A study including all activities performed by personnel located in the driller's cabin shall be carried out. It shall be ensured that none of the operators are overloaded in any of the operations.

Operation of 3rd party equipment such as casing tong shall be available from driller's cabin as required

Lighting shall be sufficient and possible to adjust to operators need.

Operators view shall be protected against direct sunlight and a wiper window/washer system shall be included

Communication and talk-back system shall be included.

Additional room in connection to driller's cabin with workstations for other personnel including printer facilities shall be included.

For detailed instrument requirement references are made to 6.45 Drilling control systems (DCS).

For detailed well control equipment references are made to 6.35 Well control system.