6. DESIGN REQUIREMENTS

Work systems and areas shall be optimised in order to ensure the personnel's health, safety and comfort, effectiveness and performance. A work system and area that is not optimised can increase the risk of fatigue, stress, errors, accidents, injury and ill health, and compromise output.
The design requirements are applicable to all parts of an installation/plant where work tasks and human activities are performed, for all modes of operation. The requirements also apply to temporary equipment and containers. Additional requirements for specific areas, work tasks, activities and specific exposure risks, are found below.

6.1 Arrangement and facilities

6.1.1

6.1.2 Daylight and solitary work

Workplaces shall be arranged to enable contact with others. Solitary work shall be avoided.

Offices, coffee bars and recreation rooms shall have access to daylight.

6.1.3 Access

There shall be easy access for operation, service, inspections, readings, maintenance and cleaning.

Where the access between two different levels is used on a daily basis, there shall be a stairway or access ramp. Temporary means of access is allowed if access is needed less than once a year.

The hierarchy of preferred access is:

1. access from ground level or floor
2. ramps
3. stairs
4. fixed inclined stepladders or spiral stairs
5. fixed vertical ladders

Access, walking platforms, walkways, stairs and ladders shall be in accordance with ISO 14122: Permanent access to machinery, all parts.

Fixed stepladders shall be provided with handrails on both sides.

At the top of vertical and inclined ladders, self-closing gates that open away from the ladder shall be installed. Gates shall not be of the gravity falling bar type.

Vertical ladders shall not interfere with the movement or removal of any item.

Vertical ladders shall be located so that openings / manhole hatches swings away from the ladder. A safety cage shall be installed on all vertical ladders where the flight height is >3 000 mm.

All ladders where there is a risk of falling to a lower level than the ladder's departure area, shall have necessary fall protection.

Access openings in vertical partitions into cofferdams, tanks etc. shall be equipped with handgrips on both sides above the opening.

Storage tanks shall have internal ladders when the height > 450 mm).

Protruding objects shall be avoided in walkways, access ways and transportation ways.

Non-slip systems shall be applied to all escape routes, access ways and work areas.

The opening force of doors in frequent use shall not exceed 65N (side hinged) and 50N (sliding door), respectively. No doors shall have an opening force in excess of 130N (side hinged) and 105N (sliding door). Mechanically assisted opening of doors shall be considered in the main path walkways. Hinged doors leading to open areas shall be provided with a damping mechanism to prevent crushing injuries.

Visual displays, gauges, level glasses etc. shall be easy to read when standing on the floor or a working platform.

It shall be possible to secure hatches in an open position.

Items most critical to system operation and which require rapid maintenance shall be most easily accessible.

Walkways shall be shown on relevant drawings.

Transportation ways where trolleys and carts are used shall not contain steps and thresholds
Work platforms shall be provided if the work tasks require the use of two hands.
Vertical and horizontal dimensions for walkways, transportation routes, work areas, platforms are given in Table 6-1.

Table 6-1: Minimum clearances in access ways and work areas

Topic	Vertical	Horizontal	Comments
Main walkways	2 100 mm (2300 mm is recommended)	1 000 mm	
Access ways (inclusive stairs)	2 100 mm (2 050 mm in door openings and above each step in a fixed stepladder)	600 mm	Minimum width 900 mm for access to permanently and intermittently manned workplaces. All access ways to consider ISO 14122-2, 4.2.2.
Transportation ways for trolleys/trucks	2 100 mm (2 300 mm is recommended)	Trolley width + 300 mm/Truck width + 900 mm	
Work areas	2 300 mm		Down to minimum 2 100 mm acceptable in parts of work areas
At work position for access to fixed equipment during operation/maintenance		700 mm space for worker	The operator's reach distance to equipment: ≤ 500 mm
FLOOR, DECK SURFACES, PLATFORMS			
Maximum unprotected openings		100 mm x 100 mm	Larger openings shall be covered or secured by guard rail or similar. Hatches with coaming height below 750 mm to be equipped with railing.
Grating opening maximum		Ø 20 mm	
Maximum height difference in one step between floor/deck levels in access ways	500 mm		
Maximum height difference in one step between floor/deck levels in access ways	350 mm		

Table 6 2: Requirements to hatch openings

Topic	Vertical	Horizontal	Comments
Hatch openings	800 mm	800 mm	Minimum 600 mm x 600 mm applies for access to cofferdams and tanks from floor/platform. Manholes shall have a minimum inner diameter of 600 mm and hand holes a minimum of 200 mm, see ISO15534-1.

6.1.4 Elevators

Installations with more than one deck shall have an elevator, unless other acceptable solutions are documented.
The elevator shall provide access to all main deck levels and in give easy access to the mechanical workshop, main stores and other decks where handling of heavy equipment is needed.
Floating production units shall be equipped with suitable elevators capable of handling equipment placed in the substructure.

6.1.5 Handrails, guard rails and barriers

Guardrails shall be provided if height to next level exceeds 500 mm. Handrails shall be continuous. Top of handle should be minimum 110 mm above floor/deck, see for further requirements NORSOK C-002.

The toe plate shall have a minimum height of 100 mm, and a clearance of maximum 10 mm to the deck.

6.1.6 Clearances, safety clearances

Safe distances according to EN 349 shall apply between moving machinery parts and fixed objects.

The minimum distances are given in Table 6-3.

Table 6-3: Minimum clearances on equipment and fixed obstruction

Topic	Vertical	Horizontal	Comments
Between pipe bottom and floor	150 mm		Does not apply to drain pipes
Between external diameter of flange and fixed obstruction	250 mm	250 mm	Applies to flanges with diameter above 100 mm on pipes DN 100 and above. Clearances can be less than 250 mm, provided there is access and space to operate maintenance tool without excessive ergonomic strain
Space between fixed cabinets and floor	Minimum 250 mm		Preferably fixed on floor without space

6.1.7 Workplace and task interaction

Workplaces shall be designed such that the personnel are not exposed to excessive workloads with risks of musculoskeletal injury.

For determination of maximum workload and force limits, see EN 1005-2, EN 1005-3 and EN 894-3. The requirements above entail that efforts should be made to avoid

- monotonous muscular load,
- excessive muscular load,
- work in fixed or static position,
- work with joints in extreme position,
- work requiring high precision and which at the same time requires substantial use of force,
- work in kneeling, squatting and lying positions,
- work of long duration and of repetitive nature with hand above shoulders or below knees,
- continuous asymmetric load on the body.

6.1.7.1 Reach, visibility and clearances

Cabin control and communication equipment shall be placed within recommended working areas for hands and/or feet from the normal working position.

From a normal working position, cabin operators shall have an unrestricted view of the equipment that he controls and of all exterior loading positions.

Kneeling and squatting operator positions shall be avoided for frequent tasks (>1/shift) . It is only permitted for a limited time period for maintenance or non-routine jobs, where such layouts are unavoidable.

6.1.7.2 Controls and displays

The term controls and displays refers to equipment in the process areas, gauges, videoconferencing systems, panels, and control rooms, cabins,

Displays may be visual, acoustic, haptic or a combination of these.

Controls may be analogue switches, buttons, levers, joysticks, touch pads, pedals.

The processes and analyses for identifying, selecting, designing, locating and testing controls and displays shall be in accordance with EN 614 Parts One and Two and EN 894 Parts One to Four.

Information and information elements presented on displays shall be consistent across different media (printed, digital, on panels) and across different media and system.

Information shall be easily comprehensible.

Controls and displays shall be clearly marked in the language of the relevant country.

Alarm systems shall be designed according to EMMUA 191 Rev 04.
Alarm information presentation (visual and auditory) shall clearly differ from other information presented to operators.

The alarms shall be given such that they can be understood and resolved in the time required for safe operation of equipment, installations and processes.

Controls and displays shall be located in a logical manner with respect to frequency of use and importance for safe operation; the movement of a control device should be consistent with the effect in direction and magnitude. They shall be clearly marked in the language of the relevant country.

Information shall be organised and presented according to recognised principles (e.g. grouped, coded and prioritised) in a manner that facilitates correct operator response to safety-critical information.

Screens, panels and lighting fixtures shall have a location that provides a satisfactory view in a normal working posture.

It shall be easy to adjust the height and angle of computer screens and keyboards, as well as their distance to the operator.

Total system overviews should be available from the displays, giving the operator opportunities to watch process performance.

Visual displays, gauges, level glasses etc. shall be within the operator's field of vision and easy to read when standing on the floor or a working platform.

If VDUs are used, information given to operators shall support task performance and be given in a manner that ensures adequate workload.

For detailed requirements to workplaces with VDUs, see C.4. The requirements apply to all VDU workplaces, also outside LQ/CCR. In Norway, DLI 528 is applicable.

6.1.7.3 Computer equipment

Computer equipment shall meet ISO 9241 part 5.

The software used shall allow variation between use of a mouse or other position instrument and the keyboard.

6.1.7.4 Consoles

6.1.7.5 Office Desks

Depth of the desk shall allow for a viewing distance up to 900 mm and the distance between the edge of the table top and keyboard shall be minimum 250 mm.

Desk tops shall have low reflective surfaces.

All multi-user workstations shall have desks that can be quickly adjusted.

For workplaces where the employees are expected to work actively in front of a screen for more than 75 % of their working day, it shall be possible to alternate between a sitting and standing work position, i.e. with a desk, which can be adjusted in height from 660 mm to 1 200 mm.

See also Norsok C-002 and ISO 9241-5.

6.1.7.6 Seats and chairs

Chairs for VDU use / Control rooms:

The chair shall provide good individual adjustment qualities and resting comfort. It shall have adjustable:
- height - minimum 400 mm to 510 mm (when the seat is in use) for normal sitting work.
- seat depth - minimum 400 mm to 450 mm.
- seat angle enabling moveable tilt with locking possibility.
- back support (height and angle) independent of the seat.
- arm rests, which can easily be removed.

Work chairs shall meet the requirements of ISO 9241-5.

Chairs for use in drillers and control cabins:

Chair design ,location and positioning shall facilitate unrestricted view of the work tasks.
There shall be easy access for both entering and leaving the operators' chairs.

The armrest supports shall be easily adaptable to the operator and the control levers. Control levers attached to the chair shall follow the chair's movement.

6.2 Specific Task related design requirements

6.2.1 Material Handling

Provisions shall be made for safe and efficient transportation of materials, both horizontally and vertically.
When designing for permanent or temporary lifting equipment, the estimated frequency of the lifting operations shall also be taken into account. For frequent/routine lifting operations, permanent equipment shall be installed.

Lifting of equipment of more than 25 kg shall be done by means of mechanical lifting.

Protruding equipment shall be avoided in lifting areas.
Transportation ways where trolleys and carts are used shall not contain steps and thresholds.

Units in everyday use shall not be stored above shoulder height (1 500 mm) and should not be stored below 900 mm.

A material handling system shall be implemented so that manual lifting of gas bottles, sacks for mud additives, cement chemicals and other adding and mixing operations is not required.

6.2.1.1 Mechanical material handling

For the choice of lifting equipment the guidelines as given in NORSOK R-002 shall be used.

Within the drilling area, it shall be possible to put pallets of sacks on the lifting table near a sack-cutting machine , using a forklift truck or pallet lift.

Trolleys, transportation tables and similar means of transportation using manual force should be easily maneuverable and have a low rolling resistance. As a minimum two of the wheels shall be lockable.

6.2.1.2 Manual material handling

The term manual handling includes lifting, carrying, pushing and pulling.

The following application of general principles should be used in design:

- Avoid manual handling activities wherever possible
- Utilize technical aids
- Optimize handling activities to reduce risk

For a method of assessment of risk related to manual handling, the standard EN 1005-2 can be used. See also Annex C&F.
For the choice of transportation equipment, manual handling forces required to operate that equipment will be taken into account, according to table……

6.2.1.3 Transport and transportation routes

6.2.1.4 Laydown

Reference is made to NORSOK R-002, Annex B, for requirement regarding Material handling

Refer to NORSOK C-001 for requirements of laydown area for galley

6.2.1.5 Storage

Storage areas and associated lay down areas should :

- Be located in the vicinity of each other and on the same level.
- Have a location that makes transportation/lifting onto/from area of use easy, efficient and without adverse load on the operator.

Have sufficient storage space near the work area for auxiliary equipment in intermittent use.

Have dedicated storage areas for scaffolding.

Maintenance and/or cleaning equipment and associated consumables should be stored in the vicinity of areas with frequent maintenance or cleaning.

Cupboards for gas bottles shall be of a non-threshold type.

6.2.2 Maintenance

6.2.2.1 Cleaning

Surfaces, structures and installations shall be easy to clean and maintain.

Equipment and fixtures shall be plinth or wall mounted.

Cabinets shall be fixed on the floor, or wall mounted with 250 mm clearance to the floor.

Slip sinks, equipment and consumables for maintenance and cleaning should be stored close to areas with frequent maintenance or cleaning. Slip sinks shall have hot and cold water, and shall be located 600mm above the floor. The distance between grids and tap shall be minimum 350mm.

Areas with frequent cleaning or need for heavy cleaning shall have drains.

Maintenance and/or cleaning equipment and associated consumables should be stored in the vicinity of areas with frequent maintenance or cleaning.

It shall be possible to clean cameras, lighting fixtures and control cabin windows in a safe manner. These windows shall be accessible both externally and internally.

It shall be possible to replace control cabin windshield wipers in a simple and safe manner.

Techniques that do not require personnel to enter tank interiors for cleaning, is recommended.

6.2.2.2 Lubrication

Configuration of equipment containing mechanical items requiring lubrication shall permit both lubrication and checking of lubricant levels without disassembly.

All lubricant fittings shall be directly accessible and should not require tubing to connect the fitting to its lubricant source.

A lubrication chart should be a permanent construction, mounted at or near the lube port or at the operator station of the equipment.

All lubrication storage or service tanks shall be labeled to identify the type of lubricant and the capacity of the tank. The label shall be seen from the filling position.

6.2.2.3 Stored energy devices

All stored energy devices shall be labeled as such and shall have a DANGER hazard warning sign attached to the device. Procedures for releasing or constraining the energy shall be displayed on the unit.

6.2.3 Valve handling

Selection of valves shall take adequate account of the ability of the expected workforce to apply and sustain the force needed to operate them. This shall include consideration of the physical size and strength, as well as gender of the workforce.

6.2.4 Waste handling

Permanent waste handling stations shall be located on the same deck level as the main waste sources.

6.3 Special Area related design requirements

6.3.1 LQ

Reference is made to NORSOK C-001 and C-002 for requirements to Living quarter.

6.3.2 Control Rooms, cabins etc.

Control Centers and Central Control Rom shall be designed according to the normative technical requirements of ISO 11064 Ergonomic design of control centers, all parts, EN 894 – all parts and EN 614-1.

Control Cabins (e.g for drillers, crane drivers, derrick men, pipe handler operators, mud control room, ROV, etc) shall be designed according to EN 894 – all parts and EN 614, The principles and design process in ISO 11064 Part One shall be applied.

Control Centers, Rooms and cabins shall be validated and verified according to ISO 11064-7.
This also applies to cabins for drillers, crane drivers, derrick men, pipe handler operators, mud control room, ROV. (the list is not exhaustive) .

6.3.3 Drilling and well area

Reference to NORSOK D-001 for requirement to drilling area concerning WE.

Design of the mud systems shall ensure that spillage of mud and cuttings are avoided.

The adding and mixing of mud shall be enclosed, atomized and adjusted with extraction system.

The system for recirculation of mud shall be enclosed and equipped with necessary ventilation.

The design of pipes and channel/ducts for transport of mud shall provide space for easy cleaning and maintenance, preferable an automatic system.

The arrangement for sampling of cuttings and mud shall be outside the polluted mud area.

Mud weight system should be automatic.

Mud tanks shall have automatic cleaning system.

Control cabins shall be ventilated with overpressure.

Emergency showers in outdoor areas (drilling area) shall be provided with warm water and wind shields.

6.3.4 Crane cabins see 6.3.2

6.4 Technical appliances

6.4.1 Control room consoles

Control room consoles shall meet the requirements of ISO 11064-4. (NB: Variation from ISO 11064-4 where CRT technology will not be used.

- Load bearing requirements for height adjustable desks should accommodate the weight of equipment, task demands, number of users and technology used.
- Depth of consoles should allow for a maximum viewing distance of 900mm and actual depth of intended display screens /monitors.

6.4.2 Machinery

Machinery shall be designed in accordance with the methods and technical principles given in EN ISO 12100 regarding working environment and human factors.

Relevant type B and type C European standards referred to in the Official Journal of the European Union under the Machinery directive (http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/machinery/index_en.htm) shall be identified and implemented.

NORSOK S-005 (Appendix xx) shall be applied for documentation requirements related to procurement of machinery. Annex G