NORSOK STANDARD C-004

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Helicopter deck on offshore installations

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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 Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.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 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) and Federation of Norwegian Manufacturing Industries (TBL).

NORSOK standards are administered and published by Standards Norway.

Introduction

This NORSOK standard is based on practical experiences accumulated from helicopter operations on the Norwegian continental shelf. Relevant information has been provided by oil companies, helicopter operators and The Foundation for Scientific and Industrial Research at The Norwegian University of Science and Technology (SINTEF). A joint industry project on helideck safety was completed in January 2000. The main conclusions and recommendations are included in this NORSOK standard.

This NORSOK standard focuses on a rational selection of design criteria and other measures, to increase safety and flight regularity in connection with offshore helicopter deck operations.

The requirements in this NORSOK standard are generally defined as functional requirements. Certain technical requirements are, however, specified when deemed necessary.

1 Scope

This NORSOK standard defines the basic requirements for design, arrangement and engineering of helicopter decks on offshore installations in the petroleum industry. This NORSOK standard covers fixed type installations, normally unmanned installations, floating installations, production, drilling and storage vessels.

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 or exceed the requirements and guidelines of the standards referenced below.

2.1 Normative references

NORSOK C-002, *Architectural components and equipment.*
NORSOK M-102, *Structural aluminium fabrication.*
NORSOK M-501, *Surface preparation and protective coating.*
NORSOK N-002, *Collection of metocean data.*
NORSOK S-001, *Technical safety.*
NORSOK S-002, *Working environment.*
BSL D5-1, *Bestemmelser for sivil luftfart (Regulation for civil aviation)*.
ICAO, *Annex 14*

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
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

3.1.2
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

3.1.3
may
verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.4
can
verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.5
helideck
dedicated helicopter landing area on offshore installations

3.2 Abbreviations

BSL	Bestemmelser for Sivil Luftfart (Regulation for Civil Aviation)
CFD	computational fluid dynamics

FPSO	floating production storage offloading
HTCC	helicopter traffic control centre
helideck	helicopter deck
ICAO	International Civil Aviation Organisation

4 General requirements

The provisions set forth in this NORSOK standard shall be complied with in all phases of planning, construction and operation of the helideck. It shall be read in conjunction with the regulation in force, and in particularly the Norwegian Civil Aviation Authority (CAA) document BSL D5-1.

The helideck design shall be viewed as an integral part of the overall installation design, and not as an isolated activity. Placement of buildings, structures, cranes, drilling derrick, hot air exhausts, flare tower, etc., may have serious consequences for the helideck flight conditions, unless appropriate measures are taken in the overall design process.

The characteristics of all physical properties, which may influence the helideck operation, shall be identified and addressed carefully as an input to the design process. The in depth knowledge of these physical properties is a key issue for successful design and safe operation of the helideck.

Physical properties in this context are wind conditions, air turbulence, emissions from turbines, flare, etc., temperature gradients, installation movements, physical objects and similar important factors and conditions. The environment created by these properties shall be related to the performance and sensitivities of the relevant types of helicopters to be in operation on the helideck.

The focus shall be on safety and flight regularity under various operational conditions.

5 Computational fluid dynamics (CFD) analysis

CFD analyses or wind tunnel tests shall be performed. A suitable model of the installation shall be built, where relevant physical properties shall be simulated and evaluated for various conditions. The findings shall be correlated with practical experience data and relevant information from the helicopter operator. Conclusions and recommendations shall verify and document that the helideck has been given an optimal location on the installation in question. Any possible problems or restrictions regarding helicopter operations shall be highlighted, to enable necessary corrective actions.

Similarly, CFD analyses or wind tunnel tests shall be performed when modifications on existing installations may affect flight performance on the helideck.

Studies shall be started in the early conceptual phase, with necessary updates during the project development.

6 Wind

The basic design principle shall be to locate the helideck in such a manner that the obstacle-free approach and take-off sector have the most favourable direction in relation to the prevailing wind sector.

The impact of wind flow near the helideck shall be carefully examined for various wind directions and conditions.

An easily visible windsock shall be installed in a location where the effect from turbulence is negligible.

NOTE More than one windsock may be required in order to comply with this requirement.

7 Mechanical turbulence and air gap

Mechanical turbulence is created by wind hitting buildings, structures and obstacles, and is in most cases predictable. A helideck location at the same level, or above surrounding structures, is therefore recommended.

An air gap shall be provided beneath the landing area. The height of the air gap shall normally be in the range of 2 m to 5 m, or more, depending on the given situation. Placement of the helideck directly on a roof or deck is unacceptable.

Installation of new modules or structures on existing petroleum installations shall be given special attention, to avoid unwanted mechanical turbulence near the helideck.

Strong turbulent wind in the approach and take-off sector is unacceptable. Such turbulence may affect the helicopter's performance regarding safety margins and lift capacity.

8 Hot air turbulence

Hot exhaust emission from turbine generators and other types of machinery on the installation, may cause turbulence. Hot air turbulence is less predictable, and may be a serious risk to helicopter operations.

Hot air flow, combined with a sudden change in air temperature, may have the following two major effects on the helicopter performance:

- possible momentary stalling of helicopter engines due to sudden air density changes through the turbinecompressors;
- significantly reduced helicopter lift capacity.

The risk of compressor stalling varies with helicopter type. In most cases it increases significantly with a momentary temperature increase of 3 °C, or more. The 3 °C isotherm shall therefore be at least 15 m above the helideck. Correct sizing and location of exhaust stacks relative to the location of the helideck is imperative. The position of the 3 °C isotherm shall be verified through the CFD analysis.

The presence of hot air flow in the vicinity of the helideck is a major risk factor to helicopter operations, and shall be given full attention.

9 Ocean waves and installation motion characteristics

Ocean waves will set floating installations and ships in motion, and the motion characteristics will vary with type of installation/ship, operational conditions, etc. Given the movement of the installation, the calculation of the helideck movement is a simple linear transformation of roll, pitch and heave movements. The low frequency surge and sway motion should be included in the calculation of the helideck movements, when relevant. An increase in height of the helideck, in relation to the installation's floatation centre, will increase the lateral movement of the helideck from roll motion.

For helicopter operations on helidecks in motion, the following limiting values shall not normally be exceeded:

Limiting condition	Limiting value during good visibility	Limiting value at night/darkness
Helideck roll:	± 3 degrees	± 2 degrees
Helideck pitch:	± 3 degrees	± 2 degrees
Helideck average heave rate:	1,0 m/s	0,5 m/s

Phenomena such as breaking waves, "green water", slamming, freak waves, etc. shall be addressed.

It is important to select a total design concept that will keep the helideck motion within the above limiting criteria most of the time, in order to obtain a high degree of safety and helicopter operational regularity. This is particularly the case for locations in a harsh environment.

10 Helicopter deck monitoring systems

A helideck monitoring system for recording of relevant meteorological data shall be provided. Such data shall include wind speed, wind direction, barometric pressure, visibility, precipitation and air temperature close to the helideck, see NORSOK N-002.

Floating installations, production, drilling and storage vessels shall be equipped with an additional monitoring system. The system shall provide information regarding the helideck's motion characteristics with respect to roll, pitch and average heave rate. The sensor(s) shall be located close to the helideck centre.

All information shall be numerically displayed, both in the central control room and the HTCC, for easy communication with helicopters in flight and helicopter land base operations.

The accuracy of the system shall be checked and verified whenever deemed necessary, but at least once every 3 years. The manufacturer's procedures shall be followed.

11 Visual references

Buildings and structures around the helideck provide good reference points for pilots during landing and take-off. By using these references the pilots know exactly where the helicopter is in space relative to the landing surface of the helideck. Visual references shall therefore be given due attention in the overall design process.

Visual references on certain type of ships (e.g. FPSOs) may be severely limited in the final descent towards the helideck. This is particularly the case when the helideck is located forward, up-front of the living quarters. In such cases, necessary measures shall be taken to improve conditions, as an integral part of the forward ship design.

12 Helideck location

The helideck shall be located in a safe area on the installation. On manned installations it shall be located above or adjacent to the living quarters, when this is feasible and appropriate. Good personnel access shall be provided to the helideck. The helideck landing surface level should be flush with the main access level to the living quarters and lift lobby to ease access and material handling.

On production vessels, drilling vessels, and storage vessels, the helideck may be located forward, mid-ship or aft, depending on the overall design philosophy.

13 Obstructions

For obstructions in the 150 degrees limited obstacle sector the following shall apply:

- no obstructions shall be higher than 0,05 x D at a distance of 0,12 x D from the edge of the helicopter deck (periphery circle);
- no obstructions shall penetrate a rising plane of ratio 1 to 2 (height to distance) between the sector circles 0,12 x D and 0,33 x D, measured from the edge of the helicopter deck (periphery circle).

where D is the maximum external dimension of the helicopter with both rotors rotating ("D" value), see Figure 1.

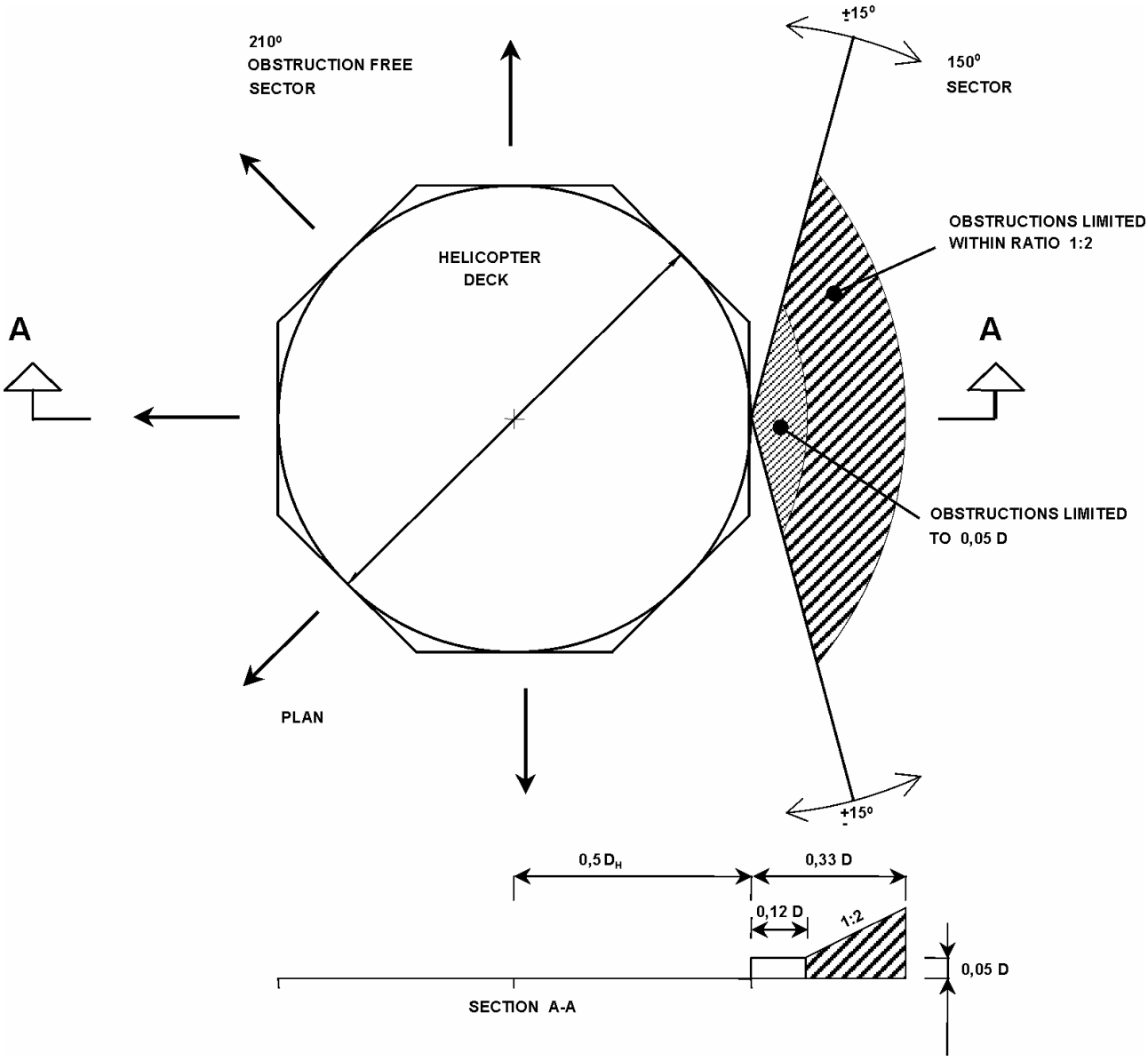

Figure 1 – Helideck obstruction zones

14 Helideck design

Decisive factors in the helideck design are safety margins, technical constraints, and human factors, i.e. the pilot's performance ability and comfort level. In practical terms this means that the helideck shall provide sufficient space for

- safe approach and take-off,
- securing of helicopter on the deck,
- safe personnel access, fuelling and off-loading of cargo,
- rescue and fire fighting from optimal directions,
- crew misjudgement, aircraft control difficulties, aircraft equipment failure, etc., i.e. safety margins,
- “effective” landing area on installations in motion,
- large national and international rescue helicopters.

The following design criteria shall apply:

Minimum helideck size:	$D_H = 1{,}0 \times D$
Minimum helideck size forward on ships:	$D_H = 1{,}0 \times D + 0{,}25 \times D$
Minimum recommended take-off weight capacity:	15 tons
Maximum allowable global deflection of the cantilever length during landing:	1/180

The sizing of the helideck is based on the following formulae:

$$D_H = f(D) + D_\Delta \quad (1)$$

where

D_H is the minimum helideck size
f (D) is a function of the actual helicopter "D" value
D_Δ is an increment to the minimum helideck size to compensate for reduced visual references and installation motions
D is the maximum external dimension of the helicopter with both rotors rotating ("D" value)

The value of D_Δ = 0,25 x D may be limited to + 5 m.

The design wind load shall be a 3 s gust based on the one-minute wind speed at 10 m above mean sea level, equal to 30 m/s.

Local operational conditions shall be taken into account when seizing and designing the helideck.

The helideck design shall be based on the largest type of helicopter anticipated to be used during the operational lifetime of the installation, taking into account any possible operations by large rescue helicopters.

15 Helideck materials and fabrication

The complete helideck, with associated walkways, stairs, hand- and guardrails, etc., should be of a prefabricated standardised type. The deck should be made of extruded load-bearing profiles, with tongue and groove connections, or similar. All functional requirements related to friction, recessed drainage, deck integrated fire fighting system, heat tracing, tie-down points, lighting, etc., shall form an integral part in order to provide an optimal, weight efficient, solution.

All materials shall be of seawater resistant aluminium. Other types of materials may be considered, but are subject to operator/company approval.

Main structural supports may be of seawater resistant aluminium or stainless steel, which do not require any surface coating. Main structural supports in carbon steel shall be fully protected with thermally sprayed on aluminium coating, in accordance with NORSOK M-501, system 2, unless specified otherwise. Dissimilar materials shall be galvanic protected.

Structural fabrication, welding and inspection shall be in accordance with NORSOK M-102, structural aluminium fabrication.

Helideck supports shall be provided with necessary vortex shedding to avoid vortex induced vibrations.

16 Helideck surface friction

The surface of the helideck shall be permanently skid-proof in all directions, and under all conditions, for both helicopters and personnel. The surface friction shall be an integral part of the deck structure (serrated surface, extruded profiles, or similar) without any additional surface treatment or coating.

The friction coefficient on a wet deck, shall be at least 0,65 in all directions between the locked helicopter wheels and the deck surface. The supplier of the helideck shall verify this by using a recognised test method within the industry (“Grip tester” or similar). The test method and results shall be documented.

Rope nets are not required for helidecks on fixed, manned installations and semi submergible installations with negligible motion characteristics, unless specified otherwise. All unmanned installations, buoy type of installations and ships, such as FPSOs, storage tankers etc., shall always be equipped with rope nets.

17 Sub-zero conditions

Helidecks exposed to sub-zero conditions, with frequent snow and ice, shall be provided with a complete, integrated heat tracing system. The surface friction shall not be impaired by snow and ice.

The system shall be activated from the console panel in the HTCC by pressing a button. The button shall illuminate when activated, and be labelled for identification.

The response time shall be maximum 5 min, with effective de-icing ability of the entire helideck surface. The system shall also provide effective de-icing of drains and down-pipes, to prevent formation of ice.

The system shall be maintenance free, and protected from possible physical damage.

18 Lowered perimeter walkway/safety net

All manned installations shall be equipped with a lowered perimeter walkway around the helideck. The walkway shall be connected to the main access route for personnel and material handling.

A minimum of three exits shall be provided from the helideck surface. They shall be placed at an angle spacing of approximately 120 degrees around the helideck. A minimum of two independent escape-ways shall be provided from the lowered perimeter walkway to safe areas. The minimum angle spacing shall be 120 degrees.

The lowered perimeter walkway shall have a minimum free width of 1 500 mm. Its deck surface shall be approximately 1 500 mm below the level of the helideck. Solid hand- and guardrails shall be provided, where the top is approximately 1 400 mm above the surface of the walkway. The walkway shall be wider near the stairs leading to the helideck, to allow for sufficient space around foam monitors, rescue equipment and any helideck lift.

The lowered perimeter walkway surface shall consist of a fine-meshed non-skid grating. The sides of the walkway shall be terminated with a solid 100 mm high toe-plate.

Normally unmanned installations may be equipped with a 1,5 m wide net around the helideck, if such a solution is more suitable than a lowered perimeter walkway. A minimum of three independent escape ways shall be provided, at an angle spacing of approximately 120 degrees. Two of the escape ways may be connected to a common walkway underneath the helideck, providing access to a safe area.

Stair handrails to the helideck shall be of a collapsible type, which, when folded down, are no higher than 250 mm above the helideck landing surface level. The folding operation shall be simple, with quick release locking bolts, or a similar device.

The design of stairs, hand- and guardrails shall otherwise comply with NORSOK C-002.

19 Fire and rescue preparedness

19.1 General

Fire-fighting and rescue equipment shall be installed in accordance with NORSOK S-001, where the requirements for the following systems are covered in detail:

- deck integrated fire fighting systems (DIFFS);
- foam monitor system (FMS);
- dual agent hose reels;
- hand operated fire-fighting extinguishers.

Relevant fire-fighting system activation buttons shall be neatly installed in the HTCC operational console. The buttons shall illuminate when activated, and be clearly labelled for identification. The buttons shall be protected from unintentional activation, and shall be controlled by two separate actions.

19.2 Helicopter deck drainage

In order to provide optimal fire fighting and rescue conditions on the helideck, the entire deck shall be provided with a recessed drainage system for safe collection and discharge of water and any dispersed fuel. The system shall be an integral part of the load-bearing profiles of the helideck. The inlet openings shall provide effective drainage, and the profile shape shall limit the combustible surface, as far as possible.

Firewater and any dispersed fuel on the helideck shall be drained to the sea in a safe, controlled and effective manner through a dedicated pipe drainage system. It is essential to prevent burning fuel from flowing over the edge of the helideck. Special attention shall be paid to drainage of helidecks in motion, i.e. helidecks on ships and floating installations.

20 Lighting

20.1 General

The helideck shall be suitably lit for operations at night and under reduced visibility conditions. The pilots shall, on approach, be able to identify the helideck and have a clear view of the helideck landing area. Structures and buildings around the helideck shall be illuminated to provide visual references.

The helideck lighting shall consist of perimeter lights, floodlights and lowered perimeter walkway lighting. All light fittings shall

- have a water tight, acid resistant stainless steel housing, (or similar non-corrosive material),
- be vibration and impact resistant,
- be none-dazzling to pilots and helideck crew,
- have long lasting tube/bulb, which is easily accessible and easy to change,
- have immediate response time of approximately 1 s,
- have protection grade IP 66/IP 67,
- have ex-certificate,
- not protrude higher than 250 mm above the helideck landing surface level.

The light fittings shall be delivered and installed complete with all necessary accessories, switches and fittings, ready for use.

Light operating buttons shall be neatly installed in the HTCC operational console, ready for use. The buttons shall illuminate when activated, and be labelled for identification.

All helideck lighting shall be connected to the uninterrupted power supply.

Helideck lighting on normally unmanned installation shall be supervised and remotely activated/deactivated from a manned installation.

It shall be verified that light fittings near the helideck area do not generate radio noise that may interfere with helicopter radio communication systems.

20.2 Perimeter lights

Perimeter lights shall be provided evenly around the deck with a maximum distance of 3 m between the light fittings. The light shall be green with correct intensity, colour and chromaticity for use offshore, as defined in ICAO Annex 14. The light source shall be protected with clear polycarbonate, or similar material. The perimeter lights shall not be visible below the landing surface plane of the helideck.

20.3 Flood lights

The entire helideck surface shall be illuminated by a screened floodlight arrangement, independent of the perimeter lighting. Adjustable xenon light fittings shall be used, unless specified otherwise by operator/company. They shall be optimally placed around the helideck, providing an even, dazzle free illumination of the helideck landing area.

The average illumination level shall be minimum 7,5 lux in the reference plane 1 m above the deck, and shall be documented by calculation. The effect of the perimeter lights shall not be included in the calculation. The following criteria apply:

- maintenance factor: 0,80;
- 1 m grid, where the number of calculation points in the x/y axis shall be specified;
- effect per unit: minimum 35 W.

As a guide for octagonal shaped helidecks, the minimum number of xenon light fittings shall be

- 8 units for helideck diameters from 22,5 m to 25 m,
- 12 units for helideck diameters from 25 m to 28,5 m,
- 14 units for helideck diameters from 28,5 m to 30 m,
- 16 units for helideck diameters from 30 m to 33,5 m.

The required number of units shall be verified by calculations in each case. It shall also be taken into consideration that certain types of helideck surfaces may "absorb" more light than others.

20.4 Illumination of lowered perimeter walkway

The lowered perimeter walkway surrounding the helideck shall be illuminated to ensure safe personnel access and orientation. This requirement also applies for any other walkway connected to the helideck.

Screened light tube type fittings shall be located on the helideck side of the walkway. The vertical light angle shall not be above the top of the outside handrail of the walkway.

20.5 Warning lights, etc.

Red warning lights for obstructions, etc. shall be provided in accordance with the regulation in force.

The highest point of the derrick, crane boom, crane cabin and other fixed obstacles on the installation, which may represent a hazard to flying, shall be marked with a red warning light, visible from all directions. A dual lantern type fitting shall be used, with automatic changeover when one lamp fails.

The derrick, crane boom and similar structures shall be fitted with red warning lights on every third part of the obstruction's total height. The maximum distance shall not be more than 20 m between the lights. At least one light at each level shall be visible in all directions.

Obstacles may also be illuminated to improve their visibility. The flare tower and obstacles in close proximity to the helideck shall always be illuminated, without dazzling the helicopter pilots.

Windsocks shall be correctly positioned and illuminated at night, easily visible for the helicopter pilots in the flight approach sector and from the take-off position on the helideck.

21 Cargo transport

A lift, lifting table or similar device, shall be provided for the vertical transportation of cargo to and from the helideck landing level, unless the helideck landing level is flush with the main access route level to the lift lobby in the living quarters.

The device shall in its upper position be flush with the helideck level, and in its lower position be flush with the living quarters lift lobby level, or the cargo handling level. A ramp lip shall be provided if the lower position cannot be completely flush. In this case, the maximum slope shall be 1:10, to facilitate movement of heavy goods.

The design of the device shall prevent objects from falling off. The location shall be away from drop zones to lifeboats or other critical areas.

A dedicated goods trolley shall be provided for material handling. The loading level shall be flush with the helicopter cargo door threshold, for easy transfer of goods.

The lifting device shall be sized to accommodate the goods trolley. The trolley shall have a dedicated parking place by the entrance to the living quarters.

22 Tie-down points

The helideck shall be fitted with winching points and necessary recessed tie-down points for securing of helicopters. Adequate drainage shall be provided to avoid build-up of water and formation of ice in the recesses.

23 Auxiliary equipment

The helideck shall be equipped with necessary weatherproof electrical connection points. A mobile starting rectifier for heavy load and shock starting operations may be provided as required. The equipment shall be compatible with the needs of the helicopter operator.

An offshore bird deterrent system is recommended near the helideck on normally unmanned installations. The system should be operated from a manned installation.

24 Marking

The edges of all coloured (non-black) marking and lettering on the helideck shall be provided with an even 30 mm black stripe to improve readability from the air.

The helideck's yellow aiming circle and the white letter "H" shall have a high intensity reflective surface, to ease landings in darkness. The reflective surface shall have long lasting properties.

25 Signs

All safety and information signs related to the helideck, helideck equipment and helideck operations, shall be strictly in accordance with BSL D5-1.

26 Inspection and maintenance access

Access to instruments, valves and equipment for operations and maintenance shall be in accordance with NORSOK S-002. All equipment to be regularly maintained shall be easily accessible.

An inspection/maintenance access system shall be provided under the portion of the helideck inaccessible from decks and gangways.

27 Utility station

A utility station containing electrical sockets and a heat traced fresh water tap, shall be provided near the helideck. A high-pressure fresh water connection point shall also be provided,when the installation is equipped with a high-pressure fresh water system. Necessary hose(s) on hose reel(s) shall be included for cleaning of the entire helideck. Whenever a high-pressure system is not available, an appropriate mobile unit, with necessary accessories, shall be provided for the same purpose.