

NORSOK STANDARD

SUBSEA STRUCTURES AND PIPING SYSTEM

U-002
Rev. 2, June 1998

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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 OLF (The Norwegian Oil Industry Association) and TBL (Federation of Norwegian Engineering Industries). NORSOK standards are administered and issued by NTS (Norwegian Technology Standards Institution).

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 Subject to implementation into international standards, the NORSOK standard will be withdrawn.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 is normative.

INTRODUCTION

Revision 2 of this standard replace revision 1 of NORSOK standard U-CR-001.

This revision has been subjected to a general update in view of past experiences and the text part of the data sheets have been moved into the body of the standard.

1 SCOPE

This NORSOK standard defines the minimum requirements for subsea structures and piping systems (template and satellite structures, manifold and riser base structures, protection structures, piping modules).

This standard is intended to give general requirements and should cover both shallow water, deep water and very deep water; diver systems and diverless systems; guideline and guidelineless systems; overtrawlable and non-overtrawlable systems, etc.

2 NORMATIVE REFERENCES

The following standards include provisions which, through reference in this text, constitute provisions 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 of the standards referenced below.

ASME B31.3	Process Piping
ASME B31.8	Gas Transmission and Distribution Piping Systems
DNV	Rules for submarine pipelines
ISO 10423	Specification for Wellhead and X-mas Tree Equipment (replaces API 6A)
ISO 10433	Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service (replaces API 14D)
ISO 14313	Specification for Pipeline Valves, Steel Gate, Plug, Ball and Check Valves (replaces API 6D)
ISO 13628-1	Petroleum and natural gas industries - Drilling and production equipment - Design and operation of subsea production systems. (Presently issued as FDIS, to be replaced with final ISO standard 13628-1 when issued. Replaces API RP 17A)
NORSOK J-003	Marine Operations
NORSOK M-001	Material Selection
NORSOK M-501	Surface preparation and protective coating
NORSOK M-503	Cathodic protection
NORSOK M-601	Welding and inspection of piping
NORSOK M-630	Material data sheets for piping
NORSOK M-650	Qualification of manufacturers of special materials
NORSOK N-001	Structural Design
NORSOK U-001	Subsea production systems

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

Shall	Verbal form used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted, unless accepted by all involved parties.
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.
May	Verbal form used to indicate a course of action permissible within the limits of the standard.
Can	Verbal form used for statements of possibility and capability, whether material, physical or casual.

Reference is made to the general list of definitions given in U-001 and ISO 13628-1.

3.2 Abbreviations

BOP	Blow-out preventer
CP	Cathodic Protection
PEEK	Polyetheretherketones
PTFE	Polytetrafluorethylene
ULS	Ultimate Limit State
ROV	Remotely Operated vehicle
ROT	Remotely Operated Tool
FAT	Factory Acceptance Test
TGB	Temporary Guide Base
ID	Internal Diameter

4 TECHNICAL REQUIREMENTS

4.1 General guidelines

The subject standard is a part of the NORSOK system of standards, and should be read with this in mind for instance will special requirements set to the structure by the marine operations be defined in J-003, material selection is covered in M-001 and intervention systems in U-007.

This standard extensively references ISO-13628-1, which shall be regarded as a supplement to this standard. The standards are supplemented by data sheets as required to specify the actual application.

4.2 Overall Requirements

4.2.1 General

The following functional requirements shall generally apply for the subsea structure and manifold system:

- a) The design life of non-retrievable equipment shall be equal to or exceed the specified field lifetime.
- b) In areas where this is required, a method for removal of or prevention of any damage or inconvenience caused by the subsea structure and manifold system upon field abandonment shall be developed. The design life and structural integrity of the structure shall allow for this operation.
- c) The subsea structure and piping system design shall comply with the intervention strategy.
- d) Requirements for protection against fishing gear and overtrawlability shall comply with project specific design basis.

4.2.2 Intervention

In addition to the recommendations and requirements given in ISO 13628-1, section 5.5.8.3 Structures, the following apply:

- a) The recommendations, “should”, given in ISO 13628-1 section 5.5.8.3 Structures shall be considered as requirements in this NORSOK standard.
- b) For entry of ROV operated tools onto valve spindles, an ROV landing frame or ROV attachment points shall be provided. The frame shall not obstruct the access for visual inspection of the piping. The valves spindles/docking receptacles shall then be located a suitable distance below/behind the ROV platform/frontplate/grating such that the torque tool can interface with the valve.
- c) Minimum two buckets, designed for easy replacement of acoustic transponders shall be provided diametric opposite on top of the structure.
- d) The landing- and surrounding areas shall be designed to withstand loads imposed by the respective intervention system during landing and operation.
- e) A design based on running retrievable modules, structures and equipment on a guidewire system, shall be in accordance with the required project standard, including guidepost top design with respect to guidewire anchor system and guidepost locking system.
- f) For guidelineless intervention systems a proper guiding system shall be provided. The guiding system shall give necessary lateral guiding as well as orientation alignment. The initial guidance
- g) system shall ensure efficient and safe entry under actual environmental conditions. The guiding structure shall be designed for relevant operational impact loads.

- h) Tighter running clearances than specified in ISO 13628-1, section 5.5.8.3.3 j, may upon agreement with operator, be accepted for final alignment.
- i) Guidewire based ROT shall be run vertically along guidewires and guideposts onto the dedicated landing area.
- j) The subsea systems shall be designed to provide sufficient access and manoeuvring space to allow the ROV systems to perform the required work at the different task sites.

For further details concerning requirements set by the intervention operations reference is made to NORSOK standard U-007.

4.2.3 Material Selection and Corrosion Protection

Material selection, fabrication and corrosion protection shall comply with the requirements in the NORSOK standard M-001 Material selection.

A corrosion protection system based on a combination of surface coating and cathodic protection shall be included in the design of subsea structures, manifolds and modules exposed to ambient seawater.

The following requirements apply with respect to the corrosion protection system:

- a) Necessary corrosion protection shall be provided, including requirements from interfacing subsystems.
- b) The design shall ensure reliable electrical continuity to each individual element for the defined design life, including continuity through the sealine termination (if relevant).
- c) Location and number of cathodic protection inspection points shall be defined and prepared for intervention.
- d) Earthing connection cables for subsea structure installed systems shall be replaceable or duplicated.

4.2.4 Design Loads

All applicable loads that may affect the subsea structure and piping system during all relevant phases such as fabrication, storing, testing, transportation, installation, drilling/completion, operation, and removal shall be included in the design.

Subsea structures shall be designed according to NORSOK standard N-001.

Production and gas injection piping systems shall be designed according to ASME B31.3 or DNV Rules for Submarine Pipelines. Header design according to DNV Rules for Submarine Pipelines may be combined with the use of ASME B31.3 for the remaining system. For simple export systems and water injection systems ASME B31.8 can be used.

Drilling loads default values are tabulated in UDS-A05.

In general, accidental loads are project specific and will be verified by a special risk analysis for the actual application. Accidental loads may include dropped objects, snag loads (fishing gear, anchors), abnormal environmental loads (earthquake), etc. Default dropped object and fishing gear loads are given in data sheet UDS-A06 and A07.

For guidelineless operations, the guiding and support structure design shall take into account actual operational and environmental conditions.

Relevant loads and load combinations for the actual application need to be defined in the project specific design basis (typical data sheet shown in ISO 13628-1 Annex F).

4.2.5 Design for overtrawability

Overtrawability design will have to be done with due consideration to access requirements.

For overtrawable structures the following requirements shall apply:

- a) The protective structure shall deflect all fishing equipment.
- b) The structure shall include corners, with the maximum true angle of 58° from the horizontal optimised to assist trawl and trawl wire deflection.
- c) Corners, ramps and equivalent structures shall penetrate the seabed to avoid snagging from trawl warp lines and ground rope. Effects from installation tolerances and expected scouring shall be accommodated.
- d) The overall geometry of the structure and the size of openings, shall be such that trawl doors are prevented from entering into the structure.
- e) If vertical side bracings are included, these shall be spaced to prevent intrusion and rotation of trawl equipment, without restricting subsea structure access for the intervention systems.

Notice should be taken to the following comments:

- All protuberances shall be minimised to prevent snagging of nets.
- The lower the structure the less effect the trawl gear will have in friction, pullover and snagging.
- All external edges/members shall have a minimum radius of 250 mm.

4.2.6 Loads from fishing gear

In areas where it is required to design the subsea system for fishing gear loads the following apply:

As a general rule, snagging shall be considered as an abnormal operation (PLS), while impact and frictional loads caused by passing fishing gear shall be regarded as normal operation (ULS) unless

frequency of trawling allows it to be considered as a PLS condition. In Annex A data sheet UDS-A07 characteristic loads for a typical North Sea location are given. Model tests may be used to document smaller loads (See Note below). Loads from beam trawls shall, in addition, be considered for areas where such equipment are being used.

When an overtrawlable/snagfree concept can be documented through model test or a geometric evaluation combined with data from relevant model tests, the following design loads can be disregarded : Trawlboard snag, Trawl Ground rope snag, Trawlboard snag on sealine.

Note: A trawl model test shall investigate the overtrawlability of the structure and quantify the trawl loads to which it may be subjected. The model test shall as a minimum simulate the following: Trawl gear type (otter/cotese, beam etc.), trawl speed, water depth, friction on seabed and structure, length, stiffness and angle of warp lines, minimum breaking strength in warp lines, bobbins and ground rope. Test procedure and set-up should be verified by the local fishing authorities and/or a fishing/trawling expert with experience from that particular area. Test set-up may vary to suit local test facilities.

4.2.7 Hatch design

All protective hatches should be fitted with hinges, be individually replaceable and allow for controlled, safe and efficient operation. Hinge direction shall be evaluated with respect to operability and requirements for simultaneous operations.

If applicable, the protective hatches shall withstand dynamic forces induced by the wire (i.e. vessel heave) during opening/closing, maximum 7 tonnes.

The protective hatches shall be designed to fall freely in water during opening/closing, but means of controlled lowering should be provided.

Any replacement of hatches or roof sections shall be performed according to the selected intervention strategy.

Any openings in grating on the roof hatches shall be sufficiently small to protect against objects that are lifted over the structure, i.e. control pods, valve inserts, etc.

4.2.8 Operational Requirements

The layout of the subsea structure and piping system shall allow for simultaneous operations as defined in the subject data sheet.

4.2.9 Test Requirements

The subsea structures and piping systems shall be subject to factory acceptance testing (FAT), integration testing/ pre-commissioning and commissioning. The extent of each test is project and system specific and shall be specified in a separate data sheet.

The FAT shall ensure and demonstrate that equipment is assembled and function in accordance with purchase order/contract requirements. FAT shall be performed for all fabricated components including components with identical design.

The integration test / pre-commissioning shall:

- a) verify correct installation, assembly and integration towards interfacing subsystems including all inspection and testing work required to verify that equipment and facilities are complete and fully installed according to approved drawings and specifications, and that all inspections and non-operational tests have been performed and recorded
- b) verify correct function of all components and systems according to approved specifications and requirement including debugging, function testing of equipment and filling of consumables.

Commissioning shall:

- 1. verify that the total subsea production system is working satisfactory as an integrated system
- 2. verify all interfaces to platform systems
- 3. demonstrate for the operation organisation that the subsea production system is ready for start-up.

Reference is also made to ISO 13628-1 section 8.4.

4.3 Requirements for Structures

4.3.1 Bottom Frame/Main Frame and Protection Structure

In addition to the recommendations and requirements given in ISO 13628-1 section 5.5.8.3 Structures the following functional requirements apply:

- a) The well supporting structure/production guide base design shall allow for individual thermal expansion of the conductor/wellhead housings. The thermal expansion data are to be included in the basis for interface tolerance design of template mounted objects. A system for monitoring well expansion may be provided
- b) A drill cuttings disposal system should be included. Alternatively accumulation of cuttings shall be considered.
- c) Snagging on the structure during pull-in and pull-out of sealines shall be avoided.
- d) All retrievable modules and structures shall if not otherwise secured, be properly locked to the bottom frame structure by means of a locking mechanism operated according to the selected intervention strategy.

- e) Where applicable protective structures shall protect the subsea equipment against damage from dropped objects and fishing gear, by use of e.g. local protection, roof hatches, etc. Ref. separate data sheets UDS-A06 and UDS-A07 in Annex A.
- f) Hinged protective structures should be designed for replacement
- g) Where applicable openings in grating on the roof hatches shall be sufficiently small to protect against objects that are lifted over the structure, i.e. control pods, valve inserts, etc.
- h) The height from top of the permanently installed equipment to underside roof, shall be sufficient to prevent any damage on the equipment if the roof is deflected by dropped objects.
- i) The structure, piping system and controls, and chemical distribution shall provide proper access for intervention operations, ref. NORSOK standard U-007.

4.3.2 Sealine Protection System

When a sealine protection system is required, the requirements to the system are given in ISO 13628-1 section 5.5.7.4 Sealine protection.

4.3.3 Interfaces for Tie-in Porches

The following interface characteristics between tie-in porches and the subsea structure shall be adhered to in design:

- a) Space requirements, including intervention.
- b) Interface tolerances, including structure and manifold piping, such as inboard hub/tie-in porch.
- c) Loads transferred to structure during tie-in, testing and operation.

4.3.4 Foundation and Levelling System

The levelling and foundation criteria for the actual application will be defined in the project design basis. In addition to the recommendations and requirements given in ISO 13628-1 section 5.5.8.4 Foundation and leveling, the following design requirements apply:

- a) Removal of soil-plug in pile top shall be possible
- b) Effects from drilling/washout shall be considered particularly for skirt based foundations
- c) The foundation design shall accommodate all relevant interface loads from sealines prior to the installation of the first conductor.

4.3.5 Installation

In addition to the recommendations and requirements given in NORSOK standard J-003 Marine Operations and ISO 13628-1 section 8.2.2 Installation method and equipment, including sub sections, the following apply:

- a) Design and arrangement of structural elements including those not being rigid members of the overall structure (e.g. hatches), shall take special considerations to drag/wave induced forces during launching/retrieval through the splash zone.
- b) Use of wire or soft rope lashing should be avoided.

4.4 Requirements for Manifold and Piping System

4.4.1 General

The manifold and piping system may be permanently integrated with the subsea structure or installed as one or several separate modules.

The following functional requirements shall apply:

- a) All critical interfaces and equipment such as valves, flanges, piping bends, connectors and small bore piping, shall allow necessary intervention work.
- b) Production piping insulation requirements are project specific and defined in data sheet.
- c) Connection/disconnection of sealines shall not affect other manifold connections.
- d) Installation and retrieval of x-mas trees on well supporting structures shall be completed without affecting manifold connections and other x-mas trees.
- e) Inspection areas and monitoring points for such as CP-measurements, wall thickness measurements, sand detection and pig signalling, shall be provided and prepared for intervention.
- f) Manifold piping joints shall be butt welded.
- g) All non welded connections in hydrocarbon bearing lines shall have metal to metal seals.
- h) Provision for installation of back-up electrical cables according to the selected intervention strategy shall be included

4.4.2 Valves

The following requirements apply for process, control and chemical injection distribution valves.

4.4.2.1 Main Design Requirements.

Valve design shall be according to ISO 10423, ISO 14313 and ISO 10433.

The material and pressure classes of the valves shall conform to the system requirements in terms of corrosion/erosion resistance and pressure class. The valves shall at least be rated to the highest system pressure e.g. max. Injection system pressure or well kill pressure.

The design of the valves shall minimise the potential for hydrate formation and damage that could be caused by possible sand, erosion or corrosion. For gate valves with vertical movement of gate,

special consideration shall be given to possibility for sand accumulation or hydrate formation in valve cavity.

Valve performance shall be unaffected when the maximum operating load combination from the connected pipe is applied. The valve supplier shall specify the limiting loads. The performance shall be demonstrated by analysis and / or testing.

Penetrations in the valve body and bonnet shall as far as possible be avoided. Any ports used for testing only, shall be sealed by welding. The primary seal shall be metal-to-metal.

For valves welded into the pipe the need for transition pieces shall be considered to ensure structural integrity.

Valves in piggable lines shall be suitable for running all applicable types of pigs and plugs in both directions. The internal profile of the valve shall minimise accumulation of debris and loose objects and the possible damages thereof. Means for ensuring correct position, fully open, shall be provided.

The valve internals shall have an antistatic design.

4.4.2.2 Sealing Requirements.

Special attention shall be paid to bonnet and stem sealing to avoid external leaks.

Body/bonnet seals shall be metal to metal or welded. A metal-to metal seal shall have pre-tensioning as the main sealing force.

The stem seal shall as a minimum consist of two separate sealing systems. One of them shall preferably be a metal-to-metal seal with pre-tensioning as the main sealing force. The seal area of the stem shall be hard-faced.

Non metallic stem seal shall be made of PTFE, PEEK or similar materials. For valves with rising stem the non metallic seal shall be protected from fluid contamination.

The stem seal be designed to prevent ingress of sea water at the design water depth with minimum internal pressure.

The valve main seal, between the gate/ball and the seats shall be metal to metal, both surfaces shall be hard faced, typically Tungsten Carbide Coating.

The seal between floating seats and body shall be made of PTFE, PEEK or similar materials.

4.4.2.3 Requirements Regarding Operation of Valves.

The valves shall be designed for failure free operation during field life. No preventive maintenance shall be planned for. As a general principle the system availability should be increased through simple designs and selection of high quality components.

For frequently operated valves with remote actuation, the retrievability of valve or valve parts should be assessed e.g. retrievability of actuator alone, actuator with valve insert, valve module or the complete manifold.

The operation of the valve shall be dictated by the overall philosophy of the field/project.

Manifold valves shall be operable in accordance with the selected intervention strategy. All valves shall have local position indicators readable by ROV/diver. Remotely operated valves shall have a means of remotely position monitoring. The design of the ROV interface shall be according to Norsok standard U-007 and/or data sheet.

The stem drive mechanism shall be designed for a torque/trust force 2,5 times higher than the estimated torque to operate a new valve with full differential pressure under the most severe load condition. The actuator or ROV torque tool interface should have a capacity of 2,0 times the same torque/trust force at max. actuator hydraulic pressure.

Torque tool interfaces shall be according to ISO 13628-4 unless otherwise agreed.

The weakest point of the valve actuation system, shall be outside the stem seal area.

For torque calculations, the friction factor between hard faced surfaces shall be 0,2 or higher, unless otherwise documented and agreed.

Removable pressure retaining cap over stem or replaceable stem seal may be required.

4.4.2.4 Material Requirements.

For general requirements reference is made to Norsok standards M-001, M-501, M-503, M-601, M-630, M-650 and M-710.

All sealing materials and sealing areas shall be resistant and unaffected by all possible fluids which may get in contact with the seals during testing, commissioning or operation. This also applies to the secondary barriers if a primary seal barrier fails.

For material selection special considerations shall be made to avoid galling. The qualification test shall demonstrate that acceptable materials have been selected.

Weld overlay UNS N00625 shall be applied in all critical areas such as seat pockets and connection areas, all bolt holes in connection with overlay areas, all surfaces forming crevices between parts with relative movements such as bearing and bushing areas. Weld overlay is not applicable for super-duplex material.

The spring material in seats and seals shall be UNS R30003, UNS R30035, Alloy 625 or Alloy C276.

The bearing/bushing base material shall be corrosion resistant i.e. PTFE coated UNS N06625.

All components exposed to the transported medium shall be suitable for sour service as specified in Norsok M-001.

All components for subsea valves shall be made of forged, wrought or hot isostatic pressed materials unless otherwise agreed.

All soft sealing materials shall be qualified and tested according to Norsok M-710.

4.4.2.5 Qualification Testing.

Prototype qualification testing shall be in accordance to ISO 10423, PR2.

If applicable, a sand slurry test according to ISO 10433 Class 2, shall be performed or documented.

The correctness of the estimated torque/trust force shall be documented in the qualification test. For gas valves all moving parts shall be completely free from lubrication oils etc.

The bonnet and stem seal shall also be tested with external pressure corresponding to the specified water depth plus a safety factor of 1,5.

Where more than one seal is installed, each seal shall be tested individually.

Stepwise seat test shall be performed to demonstrate that the valve seals properly with slow pressure increments and at all pressure levels.

4.4.2.6 Factory Acceptance Testing

Factory acceptance testing of the valves and actuators shall be conducted following ISO 10423 PSL 3 with gas test.

The testing shall register torque levels at maximum differential pressure.

Cycling test with full differential pressure shall be performed with both nitrogen and water as test medium.

Resistance measurements shall be performed to verify electrical continuity between components to be connected to the cathodic protection system, ref Norsok M-503. Valve stem, valve closing element, and other relevant parts of the valve internals shall be included in the cathodic protection system.

4.4.3 Process Piping, Production Control and Chemical Distribution System Design

The pipe routing shall:

- a) minimise level variations where liquids can be trapped (causing e.g. hydrate plugging, corrosion)
- b) minimise risk for damaging the piping during testing, installation and intervention.
- c) ensure required flexibility.
- d) Minimise number of piping sections that can be exposed to sand and particle erosion (bends, tees, etc.). Minimise number of pipe supports.

The following requirements shall apply for piggable piping systems:

- a) Bends in piggable lines should have a radius of minimum 5 times the pipe ID.

- b) Successive bends, valves, branches and combination of such, should be separated with a straight leg of minimum 3 times the pipe ID.
- c) Branches to piggable lines shall be designed to avoid collection of deposits from the pigging. The branches shall be taken above the centreline of the headers. Fabricated tees and fittings to piggable lines shall be designed for pigging.
- d) Piggable lines should have constant internal diameter, ref. DNV Rules for Submarine Pipelines, and shall accommodate for roundtrip pigging if required.

4.5 Requirements for Replacement Devices

Where considered necessary replacement devices are used for replacement and installation of structural elements and modules.

- a) Replacement devices shall be designed in compliance with the selected intervention strategy
- b) The devices shall be passive, simple, small and light for easy operation, deck handling and storage.
- c) The devices shall have padeyes for seafastening and footings for transportation and storage as required.
- d) The replacement devices shall comply with the operational requirements, seastates, intervention vessels, etc.

ANNEX A - DATA SHEETS (NORMATIVE)

Project specific requirements are defined by use of a relevant selection of the following enclosed NORSOK data sheets, some including default values :

UDS-A05	Drilling loads
UDS-A06	Dropped object loads
UDS-A07	Loads from fishing gear
UDS-A09	Subsea valve

For the following general data sheets, reference is made to ISO 13628-1 Annex F:

F1	General field data
F2	Production requirements/reservoir management
F3	Operating envelopes
F4	Subsea structures

It is considered favourable that design basis covering the following areas are also developed as early as possible for a specific field development:

- a) Intervention Strategy
- b) Guidewire anchor and guidepost locking mechanism
- c) ROV torque tools.
- d) Thermal Expansion Data
- e) Flowline data
- f) Control system design data
- g) Condition monitoring
- h) Process flowcharts
- i) Operational requirements
- j) Wellstream composition
- k) Injection requirements and media
- l) Simultaneous operations
- m) Test requirements

SUBSEA DATA SHEET			UDS-A05 U-002 Rev. 2
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TITLE: Drilling loads - for water depths up to 750 m			
Phase/Activity	Loadcase		Design Load (Template/TGB)
Lowering/ cementing of 30" conductor	1.1	Weight (load) of 30" conductor shall be carried by Template (TGB)	Vertical 600 kN (ULS) (Temporary)
Drilling of 24", lowering and cementing of 18 5/8" casing	2.1	The vertical load from weight of 30"(partly) and 18 5/8" casing will be transferred to soil via the cement, assume settling of the structure/TGB	Vertical 450 kN (ULS) (Permanent)
	2.2	Normal pull off stucked drill string (2000 kN) and rig offset 4.5° (flex joint angle), including misalignment of $\pm 1.5^\circ$. Vertical load will be carried by Conductor. Horizontal load to be carried by Template/TGB and conductor	Vertical 0 Horizontal load 160 kN (ULS)
Drilling of subsequent sections	3.1	A BOP with riser attached landing on TGB (250 tonnes at 0.5 m/s). This impact load will mainly be taken up by the conductor casing.	Vertical 31 kJ impact load (ULS)
	3.2	Normal pull of stucked drill string (2000 kN) and rig offset 4.5° (flex joint angle), including misalignment of $\pm 1.5^\circ$. Vertical load will be carried by Conductor. Horizontal load to be carried by Template/TGB and conductor	Vertical 0 Horizontal load 160 kN(ULS)
	3.3	Tension from riser (300 kN) will be taken up by TGB/Conductor casing weight. Horizontal component to be carried by TGB/Template and conductor	Vertical 0 Horizontal load 25 kN (ULS)
	3.4	Guideline tension max. is 200 kN. Vertical load will be taken up by TGB/Template weight. Horizontal comp. from 4 off lines at 4.5° to be carried by TGB/Template and conductor	Vertical 0 Horizontal load 15 kN (ULS)

The loads defined above shall be combined based on relevant combination of activities resulting in the following design loads: A. Ref. Loadcase 2.1 Vertical load 450 kN (ULS); B. Ref. Loadcase 3.1 Vertical impact load 31 kJ (ULS); C. Ref. Loadcase 3.2 + 3.3 + 3.4: 200 kN Horizontal load (ULS). B and C above shall not be combined with each other or other loads from drilling operations or fishing gear. A above shall be combined with B and with C; as well as with other relevant operational and function loads including loads from fishing gear etc.

A BOP moving sideways into the structure when lowered shall be considered for guidelineless systems. The template drilling sequence used for structural design shall be dictated by the worst case combination of loads. Drilling and well live loads should be combined when simultaneous operations are assumed.

The loads induced on the PGB/bottom frame from the well systems shall depend upon the following:

- Soil conditions, bending and axial stiffness of well system.
- Structural design and stiffness of bottom frame against vertical deflection.
- Structure/well interface design. The loads shall represent the worst case situation.

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TITLE: Drilling loads - for deep water applications 750 m to 1500 m			
Phase/Activity		Loadcase	Design Load (Template/TGB)
Lowering/ cementing of 30" conductor	1.1	Weight (load) of 30" conductor shall be carried by Template (TGB)	Vertical 600 kN (ULS) (Temporary)
Drilling of 24", lowering and cementing of 18 5/8" casing	2.1	The vertical load from weight of 30"(partly) and 18 5/8" casing will be transferred to soil via the cement, assume settling of the structure/TGB (Heavier conductors may be required)	Vertical 450 kN (ULS) (Permanent)
	2.2	Normal pull off stucked drill string, rig offset 3,5° (flex joint angle), including misalignment of $\pm 1,5^\circ$. Vertical load will be carried by Conductor. Horizontal load to be carried by Template/TGB and conductor	Vertical 0 Horizontal load 155 kN (ULS)
Drilling of subsequent sections	3.1	A BOP with riser attached landing on TGB (350 tonnes at 0,5 m/s vertical / 0,15 m/s horizontal). Vertical impact load will mainly be taken up by the conductor casing, horizontal impact load will be taken by guiding structure.	Vertical impact 44 kJ (ULS) Horizontal impact 2 kJ (ULS) (*) Horizontal impact load 33 kN (ULS)
	3.2	Normal pull off stucked drill string, rig offset 3,5° (flex joint angle), including misalignment of $\pm 1,5^\circ$ + Drilling riser tension. Vertical load will be carried by Conductor. Horizontal load to be carried by Template/TGB and conductor	Vertical 0 Horizontal 155 + 75 kN (750 m) Horizontal 155 + 160 kN (1500m) Bending moment 95 kNm (ULS)
	3.3	Extreme operating at 5,5° (flex joint angle) including misalignment of $\pm 1,5^\circ$. Drilling riser tension (2300 kN/750m, 3200kN/1500m). Vertical load will be carried by Conductor. Horizontal load to be carried by Template/TGB and conductor	Vertical 0 Horizontal 220 kN (750 m) Horizontal 310 kN (1500m) Bending moment 150kNm (PLS)
	3.4	Guideline tension max. is 200 kN (750 m) , 0 kN (1500m) Vertical load will be taken up by TGB/Template weight. Horizontal comp. from 4 off lines (4,5°) = 20 kN to be carried by TGB/Template and conductor	Vertical 0 Horizontal 20 kN (750m) Horizontal 0 kN (1500m) (ULS)
	3.5	Workover riser in open sea mode (750 m and 1500 m). Vertical load (600kN) will be carried by Conductor. Horizontal load to be carried by Template/TGB and conductor	Vertical 0 Horizontal 70 kN (750m/1500m) Bending moment 500kNm (ULS)

Load combinations: **A:** 2.1, **B:** 3.1, **C:** 3.2 + 3.4, **D:** 3.3 + 3.4, **E:** 3.5. Loadcase A shall be combined with B, C, D and E.

Loadcase A shall also be combined with other relevant operational and functional loads including fishing loads etc.

Ref also page 1 of 2.

(*) For satellite wells

SUBSEA DATA SHEET		UDS-A06		U-002, Rev. 2	
Page 1 of 1					
TITLE: Dropped object loads					
Field:		Design life:			
Location(Block/UTM):		Water depth:			
Dropped objects Impact loads from dropped objects shall be treated as a PLS condition. The impact force from actual objects that will be handled over the structure should be used as initial design loads. Alternatively the following loads may be used:					
Group	Impact energy	Impact area	Object diameter		
1: Multi Well Structures	50 kJ	Point load	700 mm		
	5 kJ	Point load	100 mm		
2: Other Structures	20 kJ	Point load	500 mm		
	5 kJ	Point load	100 mm		

SUBSEA DATA SHEET		UDS-A07		U-002 Rev. 2	
Page 1 of 1					
TITLE: Loads from fishing gear on subsea structures					
Field:			Design life:		
Location(Block/UTM):			Water depth:		

Design Load Type	Design Load Figure		
Trawl/net friction	2x200 kN	0-20 deg. vertical	ULS
Trawlboard overpull	300	0-20 deg. vertical	ULS
Trawlboard impact	13 kJ		ULS
Trawlboard snag	600 kN	0-20 deg. vertical	PLS (If not overtrawlable/snagfree)
Trawl ground rope snag	1000 kN	0-20 deg. vertical	PLS (If not overtrawlable/snagfree)
Trawlboard snag on sealine	600 kN		PLS (If not overtrawlable/snagfree)

BASIS IS LOADS FROM OTHER TRAWL FISHING GEAR

UDS-A09 SUBSEA VALVE DATA SHEET

Recommended list of information on drawing and/or data sheets may be as follows:

- *Valve type
- *Pressure class
- *Service
- *Location/water dept
- *Design lifetime
- *Nominal size
- *Inside bore
- *Design Code
- *Design standard
- *Design temperature, Flow Medium
- *Design temperature, Environment
- *Maximum differential pressure
- *Port design
- *Corrosion allowance
- *End connections
- *Process fluid
- *Body construction
- *Trim construction
- *Seat construction
- *Main seal type and material
- *Body/bonnet seal, types and material
- *Stem seal, types and material
- *Seawater ingress seal, type and material
- *Seat ring/body seal, type and material
- *Body material
- *Bonnet material
- *Stem material
- *Ball material
- *Seat material
- *External bolt, material
- *External nut, material
- *Vent and drain valves
- *Sealant injection valves
- *Surface protection
- *Type of operator
- *Valve tag number
- *Max. shell test pressure.
- *Max seat test pressure.
- *Torque at max seat differential pressure.
- * Maximum load from pipe (bending moment)