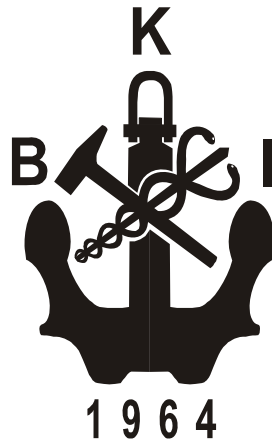


BIRO KLASIFIKASI INDONESIA

**RULES
FOR THE CLASSIFICATION
AND CONSTRUCTION OF
OFFSHORE INSTALLATIONS**



**VOLUME 7
RULES FOR FIXED OFFSHORE INSTALLATION**

EDITION 2011

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Section 1

Scope, Definitions and Procedures

A. Scope, Application

1.1 In this Volume the requirements for the different types of fixed offshore installations are defined.

1.2 Types of fixed installations

The following types have to be distinguished:

- installations permanently fixed by piling (pile foundation)
- installations resting on the sea bed by action of gravity (gravity foundation)
- installations with excess of buoyancy, connected to a base by tensioned anchoring elements (tension leg foundation)

1.3 Materials used for construction of the main structure/hull

The following materials may be used for the main structure/hull:

- steel
- reinforced concrete
- any other suitable material
- combination of above materials

2. Application

The following types of employment have to be distinguished:

- drilling/exploration
- production, e.g. oil/gas
- processing/treatment
- storage or loading on/off
- research, measurements
- other types of employment

3. Manning

The following types of manning have to be distinguished:

- continuously manned installations or units
- temporarily or intermittently manned installations
- unmanned installations

Depending on the type of employment and manning, the provisions of the Rules may have to be applied to a larger or lesser extent.

B. Definitions

1. Fixed offshore installations

Fixed offshore installations, according to these Rules, are installations for diverse purposes, see A.2., which are fixed on the seabed and are designed to be operated permanently or for a defined period at an offshore site.

2. Platform

The term “platform“ may also be used for fixed offshore installations.

3. Further definitions

For further definitions see Volume 1, Section 1, B.

C. Design Review

1. Extent of review

General specifications with an indication of the intended use, design life, location and environment, place(s) and period of construction and the main stages of construction up to final assembly and/or installation at sea have to be provided. Examination or verification of the following will be undertaken:

1.1 Specification

- design basis
- material specification
- cathodic protection specification
- painting specification, if applicable
- fabrication specification, if applicable

1.2 Special reports

- environmental report
- soil report/engineering soil report
- seismic hazard assessment, if applicable

1.3 Design reports

- weight report
- in-place analysis report
- fatigue analysis report
- earthquake analysis report, if applicable
- boat impact analysis report
- accidental analysis report
- load-out analysis report
- transport/seafastening analysis report
- lifting analysis report, if applicable
- launching analysis report, if applicable
- floatover analysis report, if applicable
- cathodic protection calculation report

1.4 Other documents

Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) when fabrication inspection is scope of work

2. Plans and calculations for approval

2.1 General

2.1.1 All documents have generally to be submitted to BKI in Bahasa Indonesia or English.

2.1.2 The general scope of documents is defined in 2.2 to 2.6, the detailed scope will be defined case by case. BKI reserve the right to demand additional documentation if that submitted is insufficient for an assessment of the installation or essential parts thereof. This may especially be the case for plants and equipment related to new developments and/or which are not tested on board to a sufficient extent.

2.1.3 Once the documents submitted have been approved by BKI they are binding on the execution of the work. Subsequent modifications and extensions require the approval of BKI before becoming effective.

2.2 Plans for main structure and design data

Plans showing the scantlings, arrangements and details of the principal parts of the structure are to be submitted for approval before construction commences. These drawings have to clearly indicate the scantlings, types and grades of materials, joint details and welding, or other methods of connection. These plans are to include the following, where applicable. Workshop drawings and parts lists are not subject to the design review.

2.2.1 General

- general arrangement
- plan indicating design loads for all decks

2.2.2 Jacket structures

- elevations
- framing
- mudmats
- padeyes
- boatlanding
- anode plan
- pile/pile make-up and marking
- pile/jacket connection (welding/grouting)
- grout details, if applicable
- ladders/stairs, if applicable
- launch frame, if applicable
- flooding system

2.2.3 Concrete structures

- formwork
- reinforcement
- pre-stressed reinforcement regarding e.g.:
 - slabs
 - walls
 - pylons

Further all drawings with respect to structural steel internals including details like embedment plates, etc.

2.2.4 Combined structures

The documentation has to be selected in analogous form as for 2.2.2 and 2.2.3.

2.2.5 Topside

- plot plans
- deck framing
- deck plating
- joint details
- handrails and grating
- ladders/stairs
- padeyes
- helicopter deck, if applicable

2.3 Plans for machinery and electrical equipment and design data

Plans are to be submitted showing the arrangement and details of:

- general arrangement of machinery installations and equipment
- technical details for auxiliary machinery
- boilers and pressure vessels
- general arrangement and particulars of the electrical installation

- fire extinguishing systems
- other pumps and piping systems
- working gear as far as it has been agreed to be included in the design review

2.4 Safety aspects

- general arrangement plans indicating location of hazardous/non-hazardous areas
- arrangement plans of safety devices and equipment, e.g. fire extinguishing plan, escape routes, life-saving appliances, structural fire protection
- operating instructions, as far as related to safety
- safety management plans, where applicable

2.5 Calculations

2.5.1 The calculations according to 1.3 are to be submitted in conjunction with the scantling plans, as may be applicable.

2.5.2 Submitted calculations are to be suitably referenced. Results from relevant model tests or dynamic response calculations may be submitted as alternatives or as substantiation for the required calculations.

2.5.3 The choice of computer programs according to the “State of the Art“ is free. It is recommended to use computer programs which are approved by BKI in advance as appropriate to solve the actual problems. If the computer programs to be used are not known to BKI, they may be checked by BKI through comparative calculations with predefined test examples. Reference applications, already achieved approvals by other institutions and other relevant information shall be provided in advance. A generally valid approval for a computer program is, however, not given by BKI.

The calculations have to be compiled in a way which allows identifying and checking all steps of the calculations with regard to input and output in an easy way. Handwritten, easily readable documents are acceptable.

Comprehensive quantities of output data shall be presented in graphic form. A written comment to the main conclusions resulting from the calculations has to be provided.

2.6 Further details

The necessary documentation is indicated in further detail in the relevant Volumes and Sections.

2.7 Distribution of documents

The distribution of design documents according to 2.2-2.6 will be agreed upon in each individual case, depending on the organization on owner's, contractor's and/or fabricator's side, and on the wishes of any Authorities involved.

For the needs of BKI, general descriptions, calculations and test reports have to be submitted in duplicate, structural plans, detail drawings and building/testing specifications in triplicate, one copy of each being returned to the remitter with the approval or review notation.

3. Operating instructions

3.1 Operating manual (Booklet)

An Operating Manual or equivalent is to be placed on each installation. The booklet shall include the following information, as applicable in the particular case, so as to provide suitable guidance to the operating personnel with regard to safe operation of the installation:

- general description / main characteristics
- pertinent data for each approved mode of operation, including design and variable loading, environmental conditions for the execution of certain operations, e.g. drilling, etc.
- minimum anticipated atmospheric and sea temperatures
- assumed seabed conditions and their control, scouring, etc.
- required distance of certain parts from the water surface
- general arrangement showing watertight compartments, closures, vents, allowable deck loading, etc.; if permanent ballast is used, the weight, location and substance used are to be clearly indicated
- capacity plan showing capacities of tanks, centres of gravity, etc.
- instructions for operation, including precautions to be taken in adverse weather, changing mode of operations, any inherent limitations of operations, etc.
- plans and description of the ballast system and instructions for ballasting, if applicable
- hazardous areas plan
- representative examples of loading conditions for each approved mode of operation, together with means for evaluation of other loading conditions
- details of emergency shutdown procedures forelectrical equipment
- identification of the helicopter used for the design of the helicopter deck and procedure for helicopter operations
- safety checks and maintenance work to be carried through
- emergency procedures and rescue operations
- operating booklet for helicopter operation, including helicopter data on which design is based

3.2 Construction portfolio (Booklet)

A set of plans showing the exact location and extent of application of different grades and strengths of structural materials, together with a description of the material and welding procedures involved, is to be placed on the installation. Any other relevant construction information is to be included in the booklet, including restrictions or prohibitions regarding repairs or modifications.

3.3 The operating instructions will be subject to examination within the design review procedure only insofar as they are related to the specified loads and load cases to be applied, and to other safety matters covered by these Rules.

4. Safety management system

4.1 Safety management procedures, increasingly in use also in offshore operations¹, may be subject to review by BKI either

- based on an agreement with the owner/operator, or
- due to authorization and request by the competent national Administration.

4.2 Safety management may be related to

- personal safety of operating personnel, i.e.
 - accident prevention
 - protection against exposure to toxic, radioactive or otherwise harmful substances
 - general preventive and health control measures (alcohol, drugs control, etc.)
- protection of the environment (sea, sea floor, atmosphere surrounding the installation)
- operational safety/operability of the technical installations/systems on the installation

Obviously, an inter-relation exists with the operating manual according to 3., see also 4.4 and 4.6.

4.3 Safety management plan

4.3.1 Safety management procedures shall be presented in the form of a Safety Management Plan (SMP), to be set up in each individual case, bearing in mind the particular operational and environmental conditions to be expected as well as the applicable legislation and regulations.

4.3.2 Preparation of a SMP will essentially consist in an assessment of all foreseeable risks emerging from the planned activities, and in providing measures

and procedures to minimize these risks and/or counteract developing danger. The assessment will be based on existing experience and statistical information regarding similar installations and activities. Proven methods of risk and failure analysis including e.g. Fault-Tree or Event-Tree diagrams may be used.

4.3.3 Corrective measures and amendments to the plan may be required following experience gathered during the initial service period, see also 4.4.

4.3.4 The SMP should take into account separately all relevant operational phases and situations and their specific risks, such as

- initial (start-up, test) period(s), also following important changes
- normal ("routine") operations
- operations under restricting conditions, e.g.
 - due to extreme environmental impact
 - during repairs, conversions, etc.
 - periods following an accident or failure

4.4 Essential elements of a SMP

4.4.1 The SMP shall clearly show, through adequate procedures and organizational provisions, that

- routine controls, checks, measurements etc. are provided in order to ensure that physical properties and chemical processes remain stable and within prescribed limits, e.g. critical gas concentrations, exposure limits, pressures, ppm values; functioning of alarms
- information and training of personnel is ensured, taking into account also possible language problems, like information on danger zones, "hazardous areas", alarms; handling of fire fighting and rescue equipment, etc.
- national regulations have to be considered
- any (new) hazards becoming known, not taken into account or not sufficiently covered in the original plan, will be evaluated and duly incorporated in a revised SMP

– communication between operating personnel, responsible company management is ensured, including immediate and reliable information on special/abnormal incidents or events defined in the SMP, see 4.4.2. In relevant cases information to Authorities and BKI is ensured.

– for any abnormal situations, e.g. repairs requiring operational restrictions, the necessary additional precautions are taken and any person possibly involved is aware of the existing danger

4.4.2 The SMP shall indicate follow-up measures and procedures ("contingencies") for each case of failure or incident considered. Responsibilities shall be clearly attributed to members of the crew/installation personnel within each contingency procedure, and the

¹ See e.g. IMO ISM (International Safety Management) procedures, to be introduced for mobile offshore units from July 2002

paths or chains of information clearly stated for the different cases.

4.4.3 For the installation in service, it shall be guaranteed by regular, and possibly additional, unprecedented, checks, audits etc., that the measures provided by the SMP are actually being observed.

Relevant documentation is to be kept on the installation and/or in the operator's headquarters for a period to be defined by the Administration, but not less than 5 years.

4.5 Types of hazards

Among aspects to be considered in assessing risks are the following:

4.5.1 Hazards to personnel

- explosion, fire
- exposure (through contact, inhalation, ingestion) to toxic, irritant or otherwise harmful gases, liquids, chemicals etc.
- accidents due to operations with lifting gear/appliances and machinery or tools
- accidents due to environmental influences (icing, unit's motions, bad visibility etc.)
- noise/vibrations exceeding given ("tolerable") limits

4.5.2 Hazards to the environment:

- Spills/loss of polluting (toxic or otherwise harmful) substances during "normal" e.g., drilling operations to the sea or sea-floor, see 4.6.2
- Spills of hydrocarbons, chemicals, etc. during transport/conveyance operations, see 4.6.1
- collision hazard, depending on weather and traffic conditions
- release of polluting (e.g. exhaust) gases to the atmosphere, see 4.6.2
- dropping of objects (e.g. wastes) to the sea/sea-floor, see 4.7
- noise exceeding prescribed limits; may be relevant in certain cases, e.g. in sensitive, protected areas

4.6 Pollution prevention during production and transport activities

4.6.1 Transport/conveyance and storing operations

4.6.1.1 Loading and unloading operations, e.g. using transport (supply) vessels and cargo handling equipment, shall be carried out observing weather imposed restrictions, see "operating instructions", and applicable safety and environment protection regulations.

4.6.1.2 For the conveyance of oil/hydrocarbon products from a production installation to a (shuttle)

tanker, using articulated piping, swivels, flexible hoses, etc., special precautions e.g., emergency shutdown and spill arresting devices may be necessary, depending on environment conditions and regulations applicable to the location. For import/export flow lines (hydrocarbons production) see also 4.6.2.

4.6.1.3 Any harmful substances subject to controlled handling shall be allocated to defined, properly sheltered and marked spaces. Liquids or substances capable of releasing harmful liquids under certain conditions shall be stored in such a way that spills are pre-vented.

4.6.1.4 Reception/receiving, use/consumption and return/unloading of harmful or polluting substances shall be constantly controlled and their volumes or weight noted.

4.6.2 Production and treatment processes

4.6.2.1 Suitable controls using "State of the Art" measuring and monitoring techniques shall be provided to ensure safe conveyance of hydrocarbons and other polluting substances to and from the offshore installation, through flow lines, risers, hoses, etc.

4.6.2.2 For safe conveyance/transport of liquid and gaseous substances on the production installation, between the different processing stations, the provisions of Volumes 4 and 5 have to be observed (material selection, design requirements, safety, monitoring and alarm devices, etc.).

4.6.2.3 Waste water, in connection with the production process, shall be either collected in storage tanks and discharged via auxiliary vessels or pipeline, or if allowed by the competent Authority pumped to the sea after prescribed treatment/purification and under controlled conditions (monitoring of ppm values).

4.6.2.4 Release of gaseous substances to the atmosphere, including flaring operations, shall occur under controlled conditions and according to the applicable regulations. Unintentional escape of gases (leakage), particularly in hazardous areas and to accommodation spaces, shall be avoided by precautions such as suitable arrangement of piping, ducts and exhaust openings/ intakes, sensors/measuring devices and alarms, pressurizing, according to the Rules, see Volumes 4 and 5.

4.7 Waste management

4.7.1 For sewage waste water the same applies as stated under 4.6.2.3 for waste water originating from the production process. The sewage residues shall be discharged or transported to corresponding installations onshore.

4.7.2 Generally, no solid wastes whatsoever (sanitary, food processing, production auxiliary materials such as for cleaning, etc.) shall be dumped from an offshore installation. Crew information and

strict adherence shall be ensured by suitable measures such as publication (posters), regular instruction and supervision.

D. Supervision of Fabrication and Installation

1. General

1.1 Supervision of the fabrication of individual components and of the installation of the structure will generally take the form of inspections by the BKI Surveyor to the extent considered necessary by BKI at any given time.

1.2 BKI Branch Offices will receive, for their supervisory work, previously examined, documents from the Head Office, see C.2.7. Additionally all technical documents connected with the relevant construction project shall be made available to the Surveyors on request.

1.3 BKI will assess the production facilities and procedures of the yard and other fabricators as to whether they meet the requirements of BKI Rules. In general, approvals based on such assessments are conditional for acceptance of products subject to testing.

1.4 Materials, components, appliances and installations subject to inspection are to comply with the relevant rule requirements and be presented for inspection and/or construction supervision by BKI Surveyors, unless otherwise provided as a result of special approvals granted by BKI.

1.5 It shall be the duty of the fabricator to inform the competent inspection office of the completion of important stages of the construction or of trials and inspections due.

1.6 In order to enable the Surveyor to fulfil his duties, he is to be given free access to the installation and the workshop, where parts requiring approval are fabricated, assembled or tested. For performance of the tests required, the yard or fabricators are to give the Surveyor every assistance by providing the staff and equipment necessary for such tests.

2. Supervision of fabrication

2.1 Aim of supervision

During the phase of fabrication of an installation BKI will ensure by surveys and inspections that:

- parts for structure and machinery and/or special equipment requiring approval have been constructed in compliance with the approved drawings and particulars

- all tests and trials stipulated by BKI Rules are performed satisfactorily
- workmanship is in compliance with current engineering standards and/or BKI Rule requirements
- welded parts are produced by qualified welders having undergone tests
- test Certificates have been presented for components requiring approval (the fabricator will have to ensure that any parts and materials requiring approval will only be delivered and installed, if the appropriate test Certificates have been issued)
- where no individual Certificates are required, type tested appliances and equipment are employed in accordance with rule requirements

2.2 Marking and attestation of individual components

2.2.1 Insofar as it is necessary to identify materials or components during the fabrication process or possibly also after commissioning, e.g. because of special properties of the material, a permanent mark is to be made by means of a stamp.

2.2.2 The construction supervision, survey and/or final inspection of materials, parts supplied or installation components, corresponding to the relevant specifications and BKI Regulations, will be attested by the Surveyor concerned on special forms, or informally, as agreed in the individual case.

3. Supervision of installation

The extent of supervision during load out, transport and installation (on site) procedures will be agreed upon according to the prevailing conditions and exigencies.

4. Industrial equipment

Regarding working gear and special equipment, supervision of construction and testing will be agreed upon from case to case.

E. Testing and Commissioning

1. Program

An overall test or commissioning program including the complete, combined function of the installation as well as partial tests of the different systems has to be established. The detailed requirements for the overall function and the functioning of the different systems are defined in the following Volumes and Sections. The test program has to be approved by BKI.

2. Tests at fabricators

As far as practicable, machinery and equipment will be subjected to operational trials on the fabricator's test bed to the scope specified in the Construction Rules. This applies also to engines produced in large series. Where the machinery, equipment or electrical installations are novel in design or have not yet sufficiently proved their efficiency under actual service conditions on board ship, BKI may require performance of a trial under particularly severe conditions.

Upon completion of work, compartments, decks, bulkheads, etc. are to be tested as specified in the following Volumes and Sections.

3. Commissioning

Commissioning tests for verification of the proper function of all systems installed have to be performed

At the site location of fixed installations in presence of the BKI Surveyor.

4. Report

A test or commissioning report has to be established by the fabricator or owner and to be agreed with the BKI Surveyor.

5. Corrective actions

If the tests according to the established test program, see 1., are partially or totally not satisfactory to the BKI Surveyor, corrective actions have to be provided by the fabricator or owner and the relevant part of the tests repeated until a satisfactory result.

Section 2

Pile Founded Structures

A. General

1. Definition and Application

1.1 Pile founded structures are fixed offshore installations founded by different types of piles reaching into the seabed and with a topside supported by a space frame structure (jacket), in general formed from steel tubes, to keep the topside above the highest water level and to transfer the loads directly to the seabed respectively to the piles.

The Class Notation **FIXED OFFSHORE STRUCTURE; PILE FOUNDATION** will be assigned for such a type, see Volume 1, Section 4, C.2.1.

1.2 The following modes of operation have to be considered:

- standard operation/production
- survival condition under extreme environmental conditions

1.3 Following additional conditions have to be considered:

- transportation to site of the main bulky elements
- load out and installation of jackets and topside

2. Scope

2.1 This Section covers those specific design criteria and features of fixed offshore installations which are not dealt with in the special Sections as referred to in the following.

2.2 Machinery and electrical installations

Machinery and electrical installations shall be designed according to Volumes 4 and 5, respectively, as applicable.

2.3 Auxiliary installations and equipment

Special (auxiliary) installations and equipment are to be designed according to the specific Sections, as applicable. See also Volume 1, Section 1.

2.4 Lifting appliances

For the interaction of lifting appliances with the installation, their foundations, etc. see Volume 2, Section 8.

The requirements for offshore cranes and other lifting appliances themselves are defined in the Regulations for the Construction and Survey of Lifting Appliances.

2.5 Transport and installation

Conditions for the transport on barges, special ships or afloat, for the lifting and installation procedures and for the operating phase while standing with the jackets on the sea-floor unpiled, shall be clearly defined in the Design Review, compare Section 1, C.

3. Elements of the structure

The structure consists of the following elements:

- topside structure which may be a space frame construction with several decks and with closed houses with living and working spaces
- special elements connected to the topside like helicopter landing decks, flares, etc.
- monotowers or jackets with 3 or more legs as space frame tube constructions
- piles in the sea-bed

B. Requirements for the Soil

1. Influence of the soil

1.1 As the fixed offshore installation is resting with the piles in the soil, the condition of the soil under the installation is of major importance for the design of the foundation and the safety of the whole installation. The following possibilities for a failure have to be investigated:

- soil resistance regarding skin friction, tip resistance
- soil settlements or displacements
- sliding of the foundation
- overturning of the foundation during the unpiled condition (on bottom stability)

1.2 The condition of the soil is subject to a Classification/Certification by BKI, and the owners and operators have to order a careful investigation on the situation of site from a recognized institution. A report on this subject is to be submitted to BKI and shall be included in the Design Review.

2. Site investigations

2.1 It is recommended that site investigations at the exact location of the installation comprise the following elements:

- site bathymetry survey
- sampling and testing of the soil at site down to sufficient depth
- laboratory tests with respect to relevant soil parameters for establishing of soil profiles
- investigation of possible effects of installation activities on the soil

2.2 Definition of permissible deviations regarding unevenness and soil profiles is necessary .

3. Interaction of seabed and structure

3.1 Scour around the foundation has to be taken into account and, if necessary, measures against have to be provided immediately after the installation of the foundation.

3.2 The effects of foundations near to each other shall be considered.

3.3 The influence of cyclic loads from the off-shore installation to the foundation and to the soil has to be investigated.

3.4 The influence of earthquake vibrations in the soil to the foundation and the complete installation shall be investigated depending on the location of the platform and the thinkable earthquake strength and frequency.

4. Additional details

For additional details see Volume 2, Section 7, B.

C. Design Loads

1. Loads on topside structure

The following loads have to be considered:

- wind loads on the topside above water level, compare Volume 2, Sections 1, B. and 2, B.2.
- snow and ice accretion, if relevant at the location, compare Volume 2, Section 2, B.6.1.
- permanent loads, like weight of structure, equipment, etc.

- functional loads, compare Volume 2, Section 2, D.
- accidental loads , compare Volume 2, Section 2, E.
- transportation and installation loads, compare Volume 2, Section 2, F.
- earthquake loads, compare Volume 2, Section 2, G.

2. Loads on jacket

The following loads on the jacket have to be considered:

- jacket weight
- jacket buoyancy
- hydrostatic pressure on jacket construction
- hydrodynamic loads from water currents and waves including influence of marine growth, compare Volume 2, Section 1, C. and Section 2, B.3.
- sea ice, ridges and icebergs, if relevant at the location, compare Volume 2, Section 1, G.
- static loads due to wind and operating forces on the topside structure, compare 1.
- hydrodynamic loads from conductors at several levels
- hydrodynamic loads from j-tubes
- damage of the jacket, e.g. from a collision of a ship with the platform
- accidental loads on the jacket by objects dropped from the working decks
- loads from other appurtenances, like ice shields, boat landing, barge bumpers
- loads from supply vessels
- earthquake loads according to Volume 2, Section 2, G.

3. Loads on piles

The following loads on the foundations have to be considered:

- Accumulated loads from the jacket according to 2. to be transferred to the soil by the piles
- load case with minimum vertical load on the piles and which is most unfavourable with respect to the pull out force
- loads during installation and piling

D. Structure

1. Basic design criteria

The following design criteria have to be applied for the structure:

- the system shall be able to withstand all loads occurring during installation, normal operation and extreme environmental conditions to be expected at the location for which it is designed, compare the loading conditions defined in Volume 2, Section 3, C.
- a sufficient air gap between the highest waves (survival condition) and the main deck shall enable a safe operation, compare Volume 2, Section 2, B.4.10
- the design shall be tolerant to damages, e.g. by collision of supply vessels with the jacket, and avoid that such an event leads to a loss of global structural integrity
- assumptions concerning the seabed conditions have to be considered, compare B.
- preferably an integrated analysis of the topside structure, jacket and pile foundation should be carried out

2. Topside structure

2.1 Structural analysis

2.1.1 The topside structure shall be designed to resist the loads defined in C.1. All permanent and functional loads are to be distributed, by an accepted method of rational analysis down to the main supports of the jacket.

2.1.2 The structure is to be considered having sufficient strength to resist all induced stresses in the operating condition. The scantlings of the structure are then to be determined consistent with this load distribution, Volume 2, Sections 1 to 4 apply.

2.1.3 Where relevant for the location of the platform, an earthquake analysis has to be performed investigating the dynamic response especially of

- primary topside structure
- drilling derrick
- flare booms
- cranes

2.2 Where necessary, blast walls have to be established to reduce the effect of explosions in the processing part.

2.3 Drilling derricks, cranes, etc.

Special attention is to be paid to the foundations and fastening of drilling derrick(s) and cranes, compare Volume 2, Section 8.

2.4 Helicopter facilities

The requirements for helicopter facilities are defined in Volume 2, Section 9.

2.5 Flares and cold vents

The requirements for flares and cold vents are defined in Volume 4, Section 14.

2.6 Life-saving appliances

The requirements for life-saving appliances are defined in Section 5.

3. Jacket

3.1 The jacket shall be designed to resist the loads defined in C.2. A complete three dimensional structural model of the jacket is required. Local analysis may be required for complex joints or other complicated structural parts.

3.2 It has to be considered that a credible collision or a dropped object against a bracing member may lead to a complete failure of the member or joint. The residual strength of the jacket has to be evaluated and the influence on the global strength of the platform assessed.

3.3 The structure is to be designed in such a way that access for inspection, maintenance and repair is to be provided, as far as possible.

3.4 In areas exposed to abrasion, e.g. by drifting ice, allowance for wear has to be considered.

E. Pile Foundation

1. Types of piles

The following types of piles may be used:

- driven piles
- drilled and grouted piles
- suction piles

2. Requirements for design

The following aspects have to be considered for the design:

- the loads according to C.3.

-
- the soil report comprising the soil parameters for the pile design has to be submitted to BKI for review
 - where piles are placed close together, pile group effects have to be considered
 - the pile/jacket connection has to be submitted for approval
 - the diameter/thickness ratio of the pile is to be controlled to avoid buckling
- pile penetration shall be obtained without damaging the pile or causing excessive disturbance of the various soil formations which may reduce their load carrying capacity
 - if no driving head is used during pile driving, allowance for cut-off at the top of the pile is to be provided

3. Further details

For further details see Volume 2, Section 7, D.

Section 3

Gravity Based Structures

A. General

1. Definition and application

1.1 Gravity based structures are fixed offshore installations with a topside supported by shafts to keep the topside above the highest water level and to transfer the loads directly to the gravity foundation at the seabed.

The Class Notation **FIXED OFFSHORE STRUCTURE; GRAVITY FOUNDATION** will be assigned for such a type, see Volume 1, Section 4, C.2.1.

1.2 The following modes of operation have to be considered:

- standard operation/production
- survival condition under extreme environmental conditions

1.3 The following additional conditions have to be considered:

- transit to site of the main bulky elements
- installation of gravity foundation, shafts and top side

2. Scope

2.1 This Section covers those specific design criteria and features of fixed offshore installations which are not dealt with in the special Sections as referred to in the following.

2.2 Machinery and electrical installations

Machinery and electrical installations shall be designed according to Volumes 4 and 5, respectively, as applicable.

2.3 Auxiliary installations and equipment

Special (auxiliary) installations and equipment are to be designed according to the specific Sections, as applicable. See also Volume 1, Section 1.

2.4 Lifting appliances

For the interaction of lifting appliances with the installation, their foundations, etc. see Volume 4, Section 8.

The requirements for offshore cranes and other lifting appliances themselves are defined in the Regulations

for the Construction and Survey of Lifting appliances.

2.5 Transport and installation

Conditions for the transport including stability criteria shall be clearly defined in the Design Review, compare Section 1, C.

3. Elements of the structure

The structure consists of the following elements:

- topside structure which may be a space frame construction with several decks and with closed houses with living and working spaces
- special elements connected to the topside like helicopter landing decks, flares, derricks, etc.
- one or more shafts
- foundation base

B. Requirements for the Seabed

1. Influence of the seabed

1.1 As the foundation of gravity based installations is resting on the seabed, the condition of the seabed under the foundation is of major importance for the design of the foundation and the safety of the whole installation. The following essential seabed characteristics will influence the decision for a gravity based structure instead of a pile founded structure:

- horizontal shear capability
- bearing strength
- short and long-term subsidence
- responses to oscillating load, e.g. possible liquefaction/fluidization
- risk of scouring and erosion

1.2 The condition of the seabed is subject to a Classification/Certification by BKI, and the owners and operators have to order a careful investigation on the situation of site from a recognized institution. A report on this subject is to be submitted to BKI and shall be included in the Design Review.

2. Site investigations

2.1 It is recommended that site investigations comprise the following elements:

- site bathymetry survey
- sampling and testing of the soil at site down to sufficient depth
- laboratory tests with respect to relevant soil parameters

2.2 Definition of permissible deviations regarding unevenness and soil profiles is necessary.

3. Interaction of seabed and structure

3.1 If the characteristics of the seabed according to 1.1 are not fully suitable and the location must be kept, the seabed has to be prepared by relevant measures.

3.2 The possibility of scour around the foundation has to be taken into account and, if necessary, measures against have to be provided immediately after the installation of the foundation.

3.3 The effects of foundations near to each other shall be considered.

3.4 The influence of cyclic loads from the offshore installation to the foundation and to the soil has to be investigated.

3.5 The influence of earthquake vibrations in the soil to the foundation and the complete installation shall be investigated depending on the location of the platform and the thinkable earthquake strength and frequency.

4. Additional details

For additional details see Volume 2, Section 7, B.

C. Design Loads

1. Loads on topside structure

The following loads have to be considered:

- wind loads on the topside above water level, compare Volume 2, Sections 1, B. and 2, B.2.
- snow and ice accretion, if relevant at the location, compare Volume 2, Section 2, B.6.1.
- permanent loads, like weight of structure, equipment, etc.
- functional loads, compare Volume 2, Section 2, D.
- accidental loads, compare Volume 2, Section 2, E.

- transportation and installation loads, compare Volume 2, Section 2, F.

- earthquake loads, compare Volume 2, Section 2 G.

2. Loads on shafts

The following loads on the shafts have to be considered:

- shaft weight
- shaft buoyancy
- hydrostatic pressure on shaft
- hydrodynamic loads from water currents and waves including influence of marine growth, compare Volume 2, Section 1, C. and Section 2, B.3.
- sea ice, ridges and icebergs, if relevant at the location, compare Volume 2, Section 1, G.
- static loads due to wind and operating forces on the topside structure, compare 1.
- hydrodynamic loads from conductors at several levels, if outside of shafts
- tank contents, if applicable
- damage of one of the shafts, e.g. from a collision of a ship with the platform
- accidental loads on the shafts by objects dropped from the working decks
- loads from other appurtenances, like ice shields, boat landing, barge bumpers
- loads from supply vessels
- earthquake loads according to Volume 2, Section 2, G.

3. Loads on base

The following loads on the gravity base have to be considered

- weight of the base
- weight of tank contents, if applicable
- hydrostatic load on base
- hydrodynamic loads due to currents at the sea-bed, compare Volume 2, Section 1, C. and Section 2, B.3.
- instability of the seabed, compare B.
- Accumulated loads from the shaft(s) according to 2. to be transferred to the soil by the gravity base
- accidental loads due to impact of dropped objects
- loads during installation

D. Structure

1. Basic design criteria

The following design criteria have to be applied for the structure:

- the system shall be able to withstand all loads occurring during installation, normal operation and extreme environmental conditions to be expected at the location for which it is designed
- the height of the main deck shall enable a safe working on the platform during normal operating conditions
- sea wash and spray water shall not occur on the main deck during normal operation conditions, but is acceptable at extreme ambient conditions where no operation of the equipment is taking place
- the design shall be tolerant to damages, e.g. by collision of a supply vessel with one shaft, and avoid that such an event leads to a loss of global structural integrity
- assumptions concerning the sea-bed conditions have to be considered, compare B.
- preferably an integrated analysis of the topside structure, shafts and gravity foundation should be carried out

2. Topside structure

2.1 Structural analysis

2.1.1 The topside structure shall be designed to resist the loads defined in C.1. All permanent and functional loads are to be distributed, by an accepted method of rational analysis down to the shaft(s).

2.1.2 The structure is to be considered having sufficient strength to resist all induced stresses in the operating condition. The scantlings of the structure are then to be determined consistent with this load distribution, Volume 2, Sections 1 to 4 apply.

2.1.3 Special attention has to be given to the load bearing elements between the topside and the shaft(s). These members have to be laid out for the maximum design loads.

2.1.4 Where relevant for the location of the platform, an earthquake analysis has to be performed investigating the dynamic response especially of:

- primary topside structure
- drilling derrick
- flare booms
- cranes

2.2 Where necessary, blast walls have to be established to reduce the effect of explosions in the processing part.

2.3 Drilling derricks, cranes, etc.

Special attention is to be paid to the foundations and fastening of drilling derrick(s) and cranes, compare Volume 2, Section 8.

2.4 Helicopter facilities

The requirements for helicopter facilities are defined in Volume 2, Section 9.

2.5 Flares and cold vents

The requirements for flares and cold vents are defined in Volume 4, Section 14.

2.6 Life-saving appliances

The requirements for life-saving appliances are defined in Section 5.

3. Shafts

3.1 The shafts shall be designed to resist the loads defined in C.2.

3.2 A complete three dimensional structural model of the shaft(s) is required.

3.3 The structure is to be designed in such a way that access for inspection, maintenance and repair is to be provided, as far as possible.

3.4 In areas exposed to abrasion, e.g. by drifting ice, allowance for wear has to be considered.

E. Foundation/Base

1. Types of foundations

The primary task of anchoring the shafts at their lower end can be met by the following types of gravity foundations:

- compact gravity foundations, without the possibility of ballasting
- gravity foundations with storage caisson for ballast water and/or tanks for the storage of oil and oil products
- gravity foundations with skirts

2. Basic design considerations

- special attention has to be paid to the integration of the shafts to the foundation base
- if the foundation is built up of reinforced concrete, the requirements of Volume 2, Section 5 have to be considered
- for further details see Volume 2, Section 7, E.

3. Compact gravity foundations

3.1 Compact gravity foundations are not equipped with tanks, but may include buoyancy chambers for transport to site.

4. Gravity foundation with tanks

4.1 Arrangements for ballasting

4.1.1 Drawings and descriptions of the ballast system and instructions for ballasting/de-ballasting have to be summarized in the Operating Manual. Measures for intact as well as for damaged condition of the installation have to be considered.

The Operating Manual has to be permanently available on the installation.

4.1.2 The ballast tanks are to be fitted with the following equipment:

- at the highest position of each tank air pipes are to be fitted and laid vertically to the main deck of the topside
- the number and arrangement of the air pipes is to be so performed that the tanks can be aerated and deaerated without exceeding the tank design pressure by over- or under-pressure
- the air pipes may also serve as overflow system leading the seawater directly to the sea
- the tanks are to be fitted with remote level indicators which are type approved by BKI
- tank filling lines are to extend to the bottom of the tank, filling lines may also be used as suction lines
- the number and capacity of the ballast pump shall satisfy the operational requirements
- for further details of the piping and pumping system Volume 4, Sections 13a – 13e shall be applied analogously

4.2 Arrangements for storage of oil and oil products

4.2.1 Drawings and descriptions of the oil storage system and instructions for loading and unloading have to be summarized in the Operating Manual.

Measures for intact as well as for damaged condition of the installation have to be considered.

The Operating Manual has to be permanently available on the installation.

4.2.2 The oil tanks are to be fitted with the following equipment:

- at the highest position of each tank air pipes are to be fitted and laid vertically to the main deck of the topside
- the number and arrangement of the air pipes is to be so performed that the tanks can be aerated and deaerated without exceeding the tank design pressure by over- or under-pressure
- an overflow system has to be installed, the overflow collecting manifolds are to be led at a sufficient gradient to an overflow tank of sufficient capacity
- the tanks are to be fitted with remote level indicators which are type approved by BKI
- tank filling lines are to extend to the bottom of the tank, filling lines may also be used as suction lines
- an oil transfer pump is to be provided backed up by a stand by pump, the capacities must satisfy the operational requirements
- for further details of the piping and pumping system Volume 4, Sections 13a – 13e shall be applied analogously

4.2.3 If oil is stored above ballast water in the same tank special measures have to be agreed with BKI.

5. Arrangement of skirts

Depending on the investigation of the seabed according to B. and based on the foundation analysis, skirts may become necessary to prevent the base from sliding. Skirts may also be necessary to avoid erosion of the seabed below the base.

If the foundation includes storage tanks, it is recommendable to situate the skirts directly below the vertical tank walls.

It is recommended to situate the skirts directly below vertical walls or other stiffeners of adequate strength.

Section 4

Tension Leg Platforms

A. General

1. Definition and application

1.1 A tension leg platform (TLP) is a floating structure connected to a foundation at the seabed by tendons which are pre-tensioned by additional buoyancy of the floating structure being pulled down under its free-floating waterline. The foundation may be a fixed gravity foundation or a pile foundation. The tendons, which are arranged normally vertical and parallel are restricting the movement of hull and top side structure (heave, pitch and roll are restrained surge, sway and yaw are allowed) thus enabling the platform to be connected to the seabed by drilling equipment or risers, etc. It will be of additional advantage to provide the floating structure in form of a column stabilized platform.

The Class Notation **FIXED OFFSHORE STRUCTURE; TENSION LEG PLATFORM** will be assigned for this type, see Volume 1, Section 4, C.2.1.

1.2 The following modes of operation have to be considered:

- standard operation/production
- survival condition under extreme environmental conditions

1.3 The following additional conditions have to be considered:

- transit of the upper floating structure/hull to the location, if relevant
- transit of the tendons, preferably also in floating condition, to the location
- transit of the pile or gravity foundation to the location, respectively
- anchoring of the tendons at the seabed and pretensioning them by increasing the draft of the floating topside

2. Scope

2.1 This Section covers those specific design criteria and features of tension leg platforms which are not dealt with in the special Sections as referred to in the following.

2.2 Subdivision and watertight integrity

Subdivision and watertight integrity are dealt with in F.

2.3 Machinery and electrical installations

Machinery and electrical installations shall be designed according to Volumes 4 and 5, respectively, as far as applicable.

2.4 Auxiliary installations and equipment

Special (auxiliary) installations and equipment are to be designed according to the specific Sections as far as applicable. See also Volume 1, Section 1, E.2.

2.5 Lifting appliances

For the interaction of lifting appliances with the installation, their foundations, etc. see Volume 2, Section 8.

The requirements for offshore cranes and other lifting appliances themselves are defined in the Regulations for the Construction and Survey of Lifting Appliances.

2.6 Transport and installation, operation

Conditions for the towing of the topside structure/hull to the location, for the transport of the foundation and the tendons to the location, for the anchoring of the tendons, for the lowering and re-elevation of the floating topside to tension the tendons shall be clearly defined in the Design Review, compare Section 1, C.

Conditions for operation of the installation, especially for controlling the tendons shall be clearly indicated in an Operating Manual, compare Section 1, C.3.1. The Operating Manual shall be permanently available on the installation.

3. Elements of the structure

The structure consists of the following elements:

- topside structure/hull which may be a deep draught floater or a column stabilized system consisting of deck structure and columns with pontoons on their lower end
- tendons as vertical tension anchors for the topside
- risers for the transport of oil and gas from the seabed to the topside
- foundation at the sea bed, provided as templates, as piles or as gravity foundation

B. Requirements for the Soil

1. Influence of the seabed

1.1 As the tendons are anchored to the seabed, the condition of the soil under the installation is of major importance for the design of the foundation and the safety of the whole installation. The following possibilities for a failure have to be investigated:

- insufficient soil resistance
- soil settlements or displacements
- sliding of the foundation
- overturning of the foundation during the unplied condition (on bottom stability)

1.2 The condition of the soil is subject to a Classification/Certification by BKI, and the owners and operators have to order a careful investigation on the situation of site from a recognized institution. A report on this subject is to be submitted to BKI and shall be included in the Design Review.

2. Site investigations

2.1 It is recommended that site investigations at the exact location of the installation comprise the following elements:

- site bathymetry survey
- sampling and testing of the soil at site down to sufficient depth
- laboratory tests with respect to relevant soil parameters for establishing of soil profiles
- investigation of possible effects of installation activities on the soil

2.2 Definition of possible horizontal and vertical tolerances for not exact installation shall be considered in the investigation.

3. Interaction of sea-bed and structure

3.1 Scour around the foundation has to be taken into account and, if necessary, measures against have to be provided immediately after the installation of the foundation.

3.2 The effects of foundations near to each other shall be considered.

3.3 The influence of cyclic loads from the off-shore installation to the foundation and to the soil has to be investigated.

3.4 The influence of earthquake vibrations in the soil to the foundation and the complete installation shall be investigated depending on the location of the platform and the thinkable earthquake strength and frequency.

4. Additional details

For additional details see Volume 2, Section 7, B.

C. Design Loads

1. Loads on hull and topside structure

The following loads have to be considered:

- hydrostatic loads on the hull depending on the actual draught
- hydrodynamic loads on the hull due to currents and waves, compare Volume 2, Section 1, C. and Section 2, B.3. and B.4.
- wind loads on hull above water level and topside structure, compare Volume 2, Sections 1, B. and 2, B.2.
- change of water level at the hull due to tides and ballasting operations
- snow and ice accretion, if relevant at the location, compare Volume 2, Section 2, B.6.1.
- sea ice, ridges and icebergs on the hull, if relevant at the location, compare Volume 2, Section 1, G.
- functional loads, compare Volume 2, Section 2, D.
- tension of tendons, compare 2.
- loads from risers, compare 4.
- loads from other appurtenances, like ice shields, boat landing, barge bumpers on the hull
- loads from supply vessels on the hull
- accidental loads on the columns or pontoons of the hull by objects dropped from the working decks
- accidental loads from a collision of a ship with the platform
- transportation and installation loads, compare Volume 2, Section 2, F.
- earthquake loads according to Volume 2, Section 2, G.

2. Loads on tendons

The following loads on the tendons have to be considered:

- tendon weight
- tendon buoyancy
- hydrostatic pressure on tendon construction
- hydrodynamic loads from water currents, etc. including influence of marine growth, compare Volume 4, Section 1, C. and Section 2, B.3.
- pretension at mean water level and changes for different levels
- variation of tension due to wind, waves and operating forces on hull and upper part of topside structure, compare 1.
- damage or replacement of one or several tendons

3. Loads on foundations

The following loads on the foundations have to be considered

- hydrodynamic loads due to currents at the seabed, compare Volume 2, Section 1, C. and Section 2, B.3.
- instability of the seabed
- tension of tendons, compare 2.
- damage or replacement of one or several tendons
- loads from risers, compare 4.
- accidental loads due to impact of dropped objects or tendon/riser failure

4. Loads on risers

The following loads on the risers have to be considered

- riser weight
- riser buoyancy
- hydrostatic pressure on riser construction
- hydrodynamic loads from water currents, etc. including influence of marine growth, compare Volume 2, Section 1, C. and Section 2, B.3.
- loads from hull/topside structure, compare 1.
- loads from foundations, compare 3.

D. Structure

1. Basic design criteria

The following design criteria have to be applied for the structure:

- the TLP system shall be able to withstand allloads occurring during installation, normal operation and extreme environmental conditions to be expected at the location for which it is designed, compare the loading conditions defined in Volume 2, Section 3, C.
- the height of the main deck shall enable a safe working on the platform during normal operating conditions
- loss of tendon tension is only acceptable within high frequent cycles and if tendons and their interfaces to foundation and topside structure are de- signed for
- the design shall be tolerant to damages as far as possible and avoid that such an event leads to a loss of global failure
- assumptions concerning the seabed conditions have to be considered, compare B.
- preferably an integrated analysis of hull, topside structure, tendons and foundation should be carried out

2. Hull and topside structure

2.1 Structural analysis

2.1.1 The buoyant hull of a tension leg platform shall be designed to resist the loads defined in C.1. All permanent and functional loads are to be distributed, by an accepted method of rational analysis down to the tendons.

2.1.2 The structure is to be considered having sufficient strength to resist all induced stresses while in the floating position and being pulled down by the tendons. The scantlings of the structure are then to be determined consistent with this load distribution, Volume 2, Sections 1 to 4 apply.

2.1.3 Structural elements such as the outer shell, decks, bulkheads and girders shall be dimensioned according to the principles outlined in Volume 4, Section 3. Rules for Hull, Volume II may be used as a basis where applicable, e.g. dimensioning of tank boundaries.

2.2 Topside structure

2.2.1 Deckhouses located near the boundary of the platform shall be designed to resist the possible impact of sea wash during conveyance.

2.2.2 Deckhouses are to have sufficient strength for their size, function and location and are to be constructed to approved plans. Their general scantlings are to be as indicated in the Rules according to 2.1.3. Where they are close to the side shell of the structure, their scantlings may be required to conform to the requirements for bulkheads of unprotected deckhouse fronts.

2.2.3 Where necessary, blast walls have to be established to reduce the effect of explosions in the processing part.

2.3 Structure in way of tendons

2.3.1 Load carrying members which may transmit loads from the tendons to the hull structure are to be designed for the maximum design loads and are to be arranged for:

- apply, control and adjust a defined tension in the tendon
- transfer vertical tension loads to the structure
- transfer side loads and hinder bending moments or rotational forces at the tendons to be transferred to the structure

2.3.2 For the pulled down position, special attention is to be paid to the distribution of the loads from the supporting points at the upper end of the tendons into the hull structure, taking account also of possible load redistributions resulting from lack of tension at one or several tendons.

The structure surrounding the points of support of the tendons shall be designed with particular regard to the introduction of local concentrated forces; main load bearing elements should be continuous in the vertical direction.

2.3.3 The inside or outside backing structure of the supporting points shall be made accessible for inspection in the operating condition.

2.3.4 For loose elements, e.g. bars, rods, bolts, pins, serving for transmission of forces to hold the platform, special requirements may be imposed regarding dimensioning (safety factors) and testing.

2.4 pontoons

Special attention shall be given to the pontoon strength of column stabilized types in way of intersection with columns and the possible reduction in strength due to cutouts and stress concentrations.

2.5 Drilling derricks, cranes, etc.

Special attention is to be paid to the foundations and fastening of drilling derrick(s) and cranes, also with regard to transit conditions, compare Volume 4, Section 8.

2.6 Helicopter facilities

The requirements for helicopter facilities are defined in Volume 2, Section 9.

2.7 Flares and cold vents

The requirements for flares and cold vents are defined in Volume 4, Section 14.

2.8 Life-saving appliances

The requirements for life-saving appliances are defined in Section 5.

3. Tendons

3.1 Tendon types

3.1.1 Tendons will normally be of the solid rod or tubular type. Tubular type tendons may be designed either with stiffened or unstiffened shells. According to the sea bed conditions envisaged, the tendons may be designed for fixed or detachable foundations.

3.1.2 Intermediate connections between parts of suitable length of a tendon may have the form of a mechanical coupling with bolted flanges /threads /clamps or of welded joints and of other systems.

3.2 Special tendon elements

3.2.1 The different types of tendons may include also buoyancy bodies, resilient elements, instrumentation for monitoring their condition, control of corrosion protection or measures for bringing down other equipment to the seabed, etc.

3.2.2 Tendon bearings

Proper consideration shall be given to the end fixation of the tendons. Depending on the type of connection, a rotational restraint of the tendon may exist also in this case.

3.2.3 Tendon tension adjustment

The adjustment devices at the top of each tendon have to be able to equalize the tension in all tendons within the limits assumed for the design.

Tension adjustment procedures and schedules are to be developed already in the design stage and have to be incorporated in the Operating Manual.

3.2.4 Tendon flexjoints

It is recommended to install flexjoints at the tendons to absorb dynamic loads. Elastomeric material in these joints has to be selected under consideration of the ambient conditions at the tendon.

3.2.5 Tendon monitoring system

3.2.5.1 The tendon system is to be equipped with a monitoring system to ensure that the tendon is operating within the design limits.

3.2.5.2 The tension monitoring system is to be established for each individual tendon and shall provide:

- continuous measuring of actual tension
- documentation of tensions measured in form of a hard copy
- an alarm (visible and audible) if tension is deviating from the design values by a pre-defined margin

- easy inspection and good repair possibilities in case of failure
- check of leakage if tendons are of watertight shell type

3.2.5.3 It is recommended to keep an accurate record of the weights taken on or taken off the platform to correlate the tendon tension with the operating activities.

3.3 Structural analysis

3.3.1 The tendons shall be designed to resist the forces and bending moments resulting from the loads defined in C.2. and considering operational conditions defined in the following. The safety factors according to loading condition 2 according to Volume 2, Section 3, C. and D. apply. For fatigue criteria, see Volume 2, Section 3, H.

As material of the tendons steel is assumed. The use of other types has to be specially considered and agreed with BKI.

3.3.2 Ocean transit condition

For ocean transit conditions of the platform, the tendons will be removed from the platform, divided into suitable length and transported separately. The approved condition is to be included in the Operating Manual.

3.3.3 Field transit condition

Field transit moves with tendons connected to the hull may only be undertaken when the depth of the water remains the same in the field and the predicted weather is such that the anticipated motions of the platform will not exceed the design condition. The duration of a field transit move may be for a considerable period of time and should be related to the accuracy of weather forecasting in the area concerned.

The approved condition is to be included in the Operating Manual.

3.3.4 Condition while lowering the platform

The maximum design motions, water depth and sea state while lowering the platform are to be clearly indicated in the Operating Manual.

3.3.5 Condition while re-elevating the platform

The tendons are to be designed to withstand the loads acting on both, the floating structure and the tendons themselves, during the re-elevating procedure. The environmental conditions are the same as foreseen for lowering the platform (3.3.4).

3.3.6 Working condition

The pretension of each tendon has to be checked regularly, see 3.2.5, and adjusted as far as possible to the design value.

3.4 Tendon failure

The tendon system and its connecting devices are to be designed in a way that the failure of one tendon does not cause other tendon failures in a progressive way. Also the connection to the topside structure and to the foundations shall in this case not create excessive damage at their support structure.

3.5 Tendon inspection

Independent from the surveying intervals for the TLP, see Volume 1, Section 5, intervals for tendon inspection have to be defined depending on the tendon design and the possibilities and speed for development of deficiencies.

4. Risers

The following aspects have to be considered for the design:

- loads according to C.4.
- the risers shall not hinder in any way the functioning of the system topside structure including hull/tendons/foundation
- other aspects of the riser system are part of the production/processing plant and not subject to Classification by BKI

E. Foundations

1. Types of foundations

The primary task of anchoring the tendons at their lower end can be met by the following foundation types:

- piles using their skin friction in the soil of the sea-bed to withstand the directly anchored tendon and its pretension
- a template anchored to the sea-bed by several piles distributing the tendon forces
- a gravity foundation using its weight to allow tensioning of all the tendons

2. Pile foundation

The following aspects have to be considered for the design:

- the loads according to C.3.
- the soil report comprising the soil parameters for the pile design has to be submitted to BKI for review
- where piles are placed close together, pile group effects have to be considered

- the pile/template connection, which may be grouted pile sleeves, steel constructions or other arrangements, has to be submitted for approval
- a smooth transition of the tendon forces to the template has to be ensured by the design
- the design of the tendon anchors to the pile or to the template has to be submitted for approval

3. Gravity foundation

The following aspects have to be considered for the design:

- the loads according to C.3.
- the ability of the soil of the sea-bed to resist the loads from the foundation is to be investigated under the consideration of the weight, sliding forces, turning moments and combinations thereof
- if the sea bed conditions are characterized by very soft mud and silt particular attention is to be given to the framing and bracing of the foundation, in order that the loads are properly distributed
- if the foundation is made of steel the requirements of Volume 4, Section 3 and 4 have to be observed
- the envelope plating of foundation tanks which are not vented freely to the sea is not to be less in thickness than would be required by the rules for tanks, using a head to the design water level taking into account the astronomical and storm tides
- if the foundation is made of concrete the requirements of Volume 4, Section 5 have to be observed
- Provisions for ballasting and de-ballasting the gravity foundation have to be installed. These may be pipelines running down at tendons into the foundation to vent off trapped air during ballasting or to induce air for displacing the water and thus de-ballasting the foundation. These pipelines may also be used to blow air under the bottom of the foundation with the aim of facilitating the lifting of the foundation from the bottom of the sea.
- the effects of scouring on the bottom bearing surface should be considered. The effects of skirt plates, where provided, have to be especially observed.

F. Subdivision, Stability and Load Line

1. Tests during construction

1.1 The weight of hull and topside structure shall be controlled by an exact calculation. It is recommended to weigh the equipment to be brought on board.

1.2 At the end of construction of hull and topside structure an inclining test shall be carried out to define the centre of gravity. For details see Volume 2, Section 7, D.

2. Intact stability

2.1 Free floating during transfer

For the free floating condition reference is made to the requirements defined in Volume 2, Section 7.

2.2 Floating in operating condition

2.2.1 During the floating of the hull with tendons already engaged the following situations with overturning moments have to be considered in addition to the conditions of 2.1:

- tendons partly engaged during the installation phase
- unequal pre-tension of the tendons
- failure of one or several tendons at one side of the structure

2.2.2 Ballasting

As ballasting of the hull/topside structure is an important activity for TLPs, the following situations have to be considered:

- change of the centre of gravity for towing, installation and operation
- establish tension of the tendons and its adjustment
- inspection and maintenance of ballast tanks
- correction of weight and centre of gravity in damage condition

2.2.3 Where the hull is made of concrete, the effect of longterm water absorption has to be considered.

2.2.4 The overturning safety, defined as the sum of the restoring moments divided by the sum of the overturning moments, should not be less than:

- 1,5 for loading condition 2
- 1,3 for loading condition 3

according to Volume 2, Section 3, C. It has to be clearly defined in the Operating Manual up to which failure stability is already secured.

2.2.5 It is assumed that noticeable inclinations of the hull will not occur or will be corrected immediately, and that the effects of any dangerous changes of the sea bed will be kept under control. Corresponding instructions shall be contained in the Operating Manual.

3. Subdivision and damage stability

3.1 Extent of damage

Depending of the type of hull the following extent of damage has to be assumed:

- any one compartment adjacent to the sea shall be assumed at a time
- any other compartment with sea water piping may be assumed flooded in case of piping failure
- for a deep draught, surface type hull a vertical extent from 6 m below waterline at lowest tide up to 10 m above highest tide, for the other parameters see Volume 2, Section 7, F.1.
- for a column stabilized type of hull the same vertical extent as for the surface type and the requirements of Volume 2, Section 7, F.3. have to be observed.
- for concrete hulls a reduced damage penetration zone may be assumed
- where a lesser extent of damage than defined above will lead to less stability, such a condition has to be considered

3.2 Stability criteria

Depending on the type of hull the stability criteria defined in Volume 2, Section 7, E. have to be met.

4. Watertight integrity

4.1 For openings in the outside shell of the hull/topside structure not only the waterline in free floating condition has to be considered, but also the operating condition with increased draught and pretensioned tendons. In addition any water level for a heel caused by unequal tendon tension, partial tension failure or environmental loads as well as increased draught and heel for damage condition shall be taken into account.

Watertight closing appliances have to be provided for any opening below the resulting highest waterline of the hull/topside structure.

4.2 For other aspects of watertight integrity see Volume 2, Section 7, G.

5. Load line

5.1 The floating hull/topside structure shall be provided with marks defining the maximum draught in all operating conditions.

5.2 For other aspects of load lines see Volume 2, Section 7, H.

Section 5

Life-Saving Appliances

A. General

1. Scope

1.1 Life-saving appliances shall comply with the relevant applicable international and/or national regulations according to 2. and shall be suitable for the type and use of the fixed offshore installation. All life-saving appliances shall be type approved.

1.2 The design and testing of lifeboats, liferafts and rescue boats with their launching appliances is in general not within the scope of Classification of offshore installations by BKI. However, their arrangement in the overall design of the installation and the structure in way of launching appliances taking into account the forces from above appliances are always part of Classification.

1.3 On special request lifeboats and rescue boats and their launching appliances may be approved by BKI on the basis of the Rules defined in 2.2.

1.4 Concerning the requirements for lifejackets, immersion suits, lifebuoys, radio life-saving appliances, distress flares and line-throwing appliances, etc. see B.1.5 and B.2.5. These requirements have to follow the regulations defined in 2.1.

2. Rules and regulations

Life-saving appliances and equipment shall comply with the relevant applicable International and/or National Regulations and BKI Rules.

2.1 International Regulations

- International Maritime Organisation (IMO): International Convention for the Safety of Life at Sea (SOLAS), Chapter III - Life-Saving Appliances and Arrangements, as far as practicable
- IMO: International Life-Saving Appliance Code (LSA Code), Resolution MSC.48(66)
- IMO: Testing and Evaluation of Life-Saving Appliances, Resolution MSC.81(70), amended by MSC.200(80)

2.2 BKI Rules

- Regulations for Life boats and Rescue Boats

- Regulations for Live-Saving Launching Appliances

3. Emergency warnings and instructions

3.1 Alarm signals

For alarm and public address system see Volume 5, Section 9.

3.2 Operating instructions

Illustrations and instructions shall be provided on or in the vicinity of lifeboats and liferafts and their launching controls and shall:

- illustrate the purpose of controls and the procedures for operating the appliance and give relevant instructions or warnings
- be easily readable under emergency lighting conditions
- use symbols in accordance with the recommendations of SOLAS, MODU Code, National Regulations, etc. as far as applicable

B. Life-Saving Appliances

1. Type and equipment

1.1 Life-saving appliances shall be suitable for the type and use of the fixed offshore installation.

1.2 The lifeboats shall meet the requirements of the LSA Code, Chapter IV and the Testing Regulations defined in A.2.1 and shall be of the following type:

- totally enclosed lifeboats launched by falls with fire protection and self-contained air support system considering LSA Code § 4.6, 4.8 and 4.9, or
- free-fall lifeboats with fire protection and self-contained air support system considering LSA Code § 4.7 to 4.9

1.3 Liferafts in numbers according to 2. shall meet the requirements for davit-launched liferafts of the LSA Code, Chapter IV and the Testing Regulations defined in A.2.1. Normally they need not be equipped with float-free arrangements and hydrostatic release units.

1.4 Lifeboats and liferafts shall be fully equipped as required by the LSA Code, Chapter IV defined in A.2.1. However, for operation in restricted areas items may be dispensed by the Administration of the state of flag or location.

1.5 Personal life-saving appliances shall meet the requirements of the regulations of the relevant Administration and of BKI considering the climatic conditions at the operating location of the installation.

2. Number and size

2.1 The number and size of life-saving appliances has to be defined according to the regulations mentioned in A.2.1

If not stated otherwise by the responsible Administration, each manned installation should be provided with at least the lifeboats and liferafts listed in the following:

2.2 Each installation shall carry lifeboats, installed in at least two widely separated locations on different sides or ends of the installation. The arrangement of lifeboats shall provide for each location sufficient capacity to accommodate the total number of persons on the installation if all the lifeboats in any one location are lost or rendered unusable.

2.3 In addition liferafts shall be carried of such aggregate capacity as will accommodate the total number of persons on the installation.

2.4 In the case of fixed installations where, due to its size or configuration, lifeboats cannot be located in widely separated locations to satisfy 2.2, the Administration of the state of location or flag may permit the aggregate capacity of the lifeboats to accommodate only the total number of persons on the installation. However, the liferafts should be served by launching appliances.

2.5 As a minimum personal life saving appliances have to be provided for every person on the installation. At special locations, like muster stations, additional equipment has to be stored.

C. Arrangement of Lifeboats and Liferafts

1. Muster and embarkation arrangements

1.1 If separate, muster stations shall be provided close to the embarkation stations. Each muster station shall have sufficient space to accommodate all persons assigned to muster at that station.

1.2 Muster and embarkation stations shall be readily accessible from accommodation and work areas. They shall not be arranged at locations with explosion hazard.

1.3 Muster and embarkation stations shall be adequately illuminated by emergency lighting.

1.4 Alleyways, stairways and exits giving access to the muster and embarkation stations shall be adequately illuminated by emergency lighting.

1.5 Davit-launched survival craft muster and embarkation stations shall be so arranged as to enable stretcher cases to be placed in survival craft.

1.6 Survival craft embarkation arrangements shall be so designed that:

- lifeboats can be boarded by their full complement of persons within 3 minutes from the time the instruction to board is given
- lifeboats can be boarded and launched directly from the stowed position
- davit-launched liferafts can be boarded and launched from a position immediately adjacent to the stowed position or from a position to which the liferaft is transferred prior to launching in compliance with 3.3
- where necessary, means shall be provided for bringing the davit-launched liferaft to structure side and holding it alongside so that persons can be safely embarked

2. Stowage

2.1 Each lifeboat and liferaft shall be stowed:

- so that neither they nor their stowage arrangements will interfere with the operation of any other lifeboat or liferaft or rescue boat at any other launching station
- as near the water surface as is safe and practicable
- in a state of continuous readiness so that two crew members can carry out preparations for embarkation and launching in less than 5 minutes
- as far as practicable, in a secure and sheltered position and protected from damage by fire and explosion

2.2 Lifeboats shall be stowed

- that they are protected from damage by heavy seas
- attached to launching appliances

2.3 Liferafts shall be stowed:

- as to permit manual release from their securing arrangements

- within reach of the lifting hooks, if liferafts are davit-launched; unless some means of transfer is provided which is not rendered inoperable by power failure, etc.

3. Launching and recovery arrangements

3.1 Launching appliances shall be provided for all lifeboats and davit-launched liferafts. Depending on the height of the stowage position above sea level free-fall launching may be provided. The launching appliances shall meet the requirements defined in the Rules and Regulations given in A.2.

3.2 Launching stations shall be in such positions as to ensure safe launching. The prevailing directions of wind and sea currents have to be considered. In addition the configuration of jackets and shafts shall be taken into account and the position shall be so arranged as to come clear of any structural obstacles below the structure of the installation,. The exact position has to be agreed with the Administration and BKI.

3.3 Preparation and handling of survival craft at any one launching station shall not interfere with the prompt preparation and handling of any other survival craft or rescue boat at any other station.

3.4 Means shall be available to prevent any discharge of fluids on to lifeboats or liferafts during abandonment.

3.5 During preparation and launching, lifeboats and liferafts, its launching appliance and the area in the water into which they are to be launched shall be adequately illuminated by emergency lighting.

3.6 Launching and recovery arrangements shall be such that the appliance operator on the installation is able to observe the survival craft at all times during launching and lifeboats during recovery.

3.7 Falls, where used, shall be long enough for the survival craft to reach the water with the unit under unfavourable conditions, such as maximum air gap, lightest transit or operational condition or any damaged condition as described in Section 5.

Only one type of release mechanism shall be used for similar survival craft on the installation and the opening of the mechanism shall be possible under load from inside the boat.

3.8 In any case of damage defined in the previous Sections, lifeboats with an aggregate capacity of not less than 100 % of persons on board shall, in addition to meeting all other requirements of launching and stowage defined in this Section, be capable of being launched clear of any obstruction.

D. Rescue Boats

1. Number and requirements

Each installation shall carry at least one fast rescue boat complying with the requirements of rules and regulations defined in A.2.

2. Stowage

Rescue boats shall be stowed:

- in a state of continuous readiness for launching in not more than 5 minutes
- in a position suitable for launching and recovery
- so that neither the rescue boat nor its stowage arrangements will interfere with the operation of any lifeboat or raft of another launching station

3. Embarkation and launching

The rescue boat embarkation and launching arrangements shall be such that the rescue boat can be boarded and launched in the shortest possible time.

Launching arrangements shall include a single point hoist and release mechanism and in other aspects comply with C.3.

4. Recovery

Rapid recovery of the rescue boat shall be possible when loaded with its full complement of at least six persons and the relevant equipment.

Annex A

List of Standards, Codes, etc. Quoted

Table A.1 List of Standards, Codes, etc. Quoted

Volume / Section	IACS UR	IMO	Others
3/1	(D1.3.1) (D1.3.2) (D1.6) (D.2.2) (D.3.1) (D.3.2) (D4)	ISM – July 2002	
3/4	(D.4.3.8)	(MODU)	
3/5		SOLAS, LSA MSC.48(66) IMO Testing MSC.81(70) MSC.200(80) (MODU)	
<p>Explanation of abbreviations:</p> <p>D1 – D12 Requirements concerning Mobile Offshore Drilling Units, Unified Requirements of IACS, 1996</p> <p>IACS International Association of Classification Societies</p> <p>IMO International Maritime Organization</p> <p>IMO Testing Testing and Evaluation of Life-Saving Appliances by IMO Resolution MSC.81(70)</p> <p>ISM IMO International Safety Management Procedures, 1 July 2002</p> <p>LSA International Life-Saving Appliance Code issued by IMO Resolution MSC.48(66)</p> <p>MODU Code for the Construction and Equipment of Mobile Offshore Drilling Units, issued by IMO</p> <p>SOLAS Safety of Life at Sea, issued by IMO</p> <p>(.....) reference not explicitly declared in the text</p>			