Tasneef®
Life Environmentally Optimized

Rules for the Classification of Steel Fixed Offshore Platforms

Effective from 15 August 2015

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GENERAL CONDITIONS

Definitions:

"*Administration*" means the Government of the State whose flag the Ship is entitled to fly or under whose authority the Ship is authorized to operate in the specific case.

"IACS" means the International Association of Classification Societies.

"*Interested Party*" means the party, other than the Society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.

"*Owner*" means the registered owner, the ship owner, the manager or any other party with the responsibility, legally or contractually, to keep the ship seaworthy or in service, having particular regard to the provisions relating to the maintenance of class laid down in Part A, Chapter 2 of the Rules for the Classification of Ships or in the corresponding rules indicated in the specific Rules.

"Rules" in these General Conditions means the documents below issued by the Society:

- (i) Rules for the Classification of Ships or other special units;
- (ii) Complementary Rules containing the requirements for product, plant, system and other certification or containing the requirements for the assignment of additional class notations;
- (iii) Rules for the application of statutory rules, containing the rules to perform the duties delegated by Administrations;
- (iv) Guides to carry out particular activities connected with Services;
- (v) Any other technical document, as for example rule variations or interpretations.

"*Services*" means the activities described in Article 1 below, rendered by the Society upon request made by or on behalf of the Interested Party.

"Ship" means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.

"*Society*" or *"TASNEEF"* means Tasneef and/or all the companies in the Tasneef Group which provide the Services.

"*Surveyor*" means technical staff acting on behalf of the Society in performing the Services.

Article 1

1.1. The purpose of the Society is, among others, the classification and certification of ships and the certification of their parts and components. In particular, the Society:
- (i) sets forth and develops Rules;
- (ii) publishes the Register of Ships;
- (iii) issues certificates, statements and reports based on its survey activities.

1.2. The Society also takes part in the implementation of national and international rules and standards as delegated by various Governments.

1.3. The Society carries out technical assistance activities on request and provides special services outside the scope of classification, which are regulated by these general conditions, unless expressly excluded in the particular contract.

Article 2

2.1. The Rules developed by the Society reflect the level of its technical knowledge at the time they are published. Therefore, the Society, although committed also through its research and development services to continuous updating of the Rules, does not guarantee the Rules meet state-of-the-art science and technology at the time of publication or that they meet the Society's or others' subsequent technical developments.

2.2. The Interested Party is required to know the Rules on the basis of which the Services are provided. With particular reference to Classification Services, special attention is to be given to the Rules concerning class suspension, withdrawal and reinstatement. In case of doubt or inaccuracy, the Interested Party is to promptly contact the Society for clarification.
The Rules for Classification of Ships are published on the Society's website: www.tasneef.ae.

2.3. The Society exercises due care and skill:
- (i) in the selection of its Surveyors
- (ii) in the performance of its Services, taking into account the level of its technical knowledge at the time the Services are performed.

2.4. Surveys conducted by the Society include, but are not limited to, visual inspection and non-destructive testing. Unless otherwise required, surveys are conducted through sampling techniques and do not consist of comprehensive verification or monitoring of the Ship or of the items subject to certification. The surveys and checks made by the Society on board ship do not necessarily require the constant and continuous presence of the Surveyor. The Society may also commission laboratory testing, underwater inspection and other checks carried out by and under the responsibility of qualified service suppliers. Survey practices and procedures are selected by the Society based on its experience and knowledge and according to generally accepted technical standards in the sector.

Article 3

3.1. The class assigned to a Ship, like the reports, statements, certificates or any other document or information issued by the Society, reflects the opinion of the Society concerning compliance, at the time the Service is provided, of the Ship or product subject to certification, with the applicable Rules (given the intended use and within the relevant time frame).
The Society is under no obligation to make statements or provide information about elements or facts which are not part of the specific scope of the Service requested by the Interested Party or on its behalf.

3.2. No report, statement, notation on a plan, review, Certificate of Classification, document or information issued or given as part of the Services provided by the Society shall have any legal effect or implication other than a representation that, on the basis of the checks made by the Society, the Ship, structure, materials, equipment, machinery or any other item covered by such document or information meet the Rules. Any such document is issued solely for the use of the Society, its committees and clients or other duly authorised bodies and for no other purpose. Therefore, the Society cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by the Society. The validity, application, meaning and interpretation of a Certificate of Classification, or any other document or information issued by the Society in connection with its Services, is governed by the Rules of the Society, which is the sole subject entitled to make such interpretation. Any disagreement on technical matters between the Interested Party and the Surveyor in the carrying out of his functions shall be raised in writing as soon as possible with the Society, which will settle any divergence of opinion or dispute.

3.3. The classification of a Ship, or the issuance of a certificate or other document connected with classification or certificate on and in general with the performance of Services by the Society shall have the validity conferred upon it by the Rules of the Society at the time of the assignment of class or issuance of the certificate; in no case shall it amount to a statement or warranty of seaworthiness, structural integrity, quality or fitness for a particular purpose or service of any Ship, structure, material, equipment or machinery inspected or tested by the Society.

3.4. Any document issued by the Society in relation to its activities reflects the condition of the Ship or the subject of certification or other activity at the time of the check.

3.5. The Rules, surveys and activities performed by the Society, reports, certificates and other documents issued by the Society are in no way intended to replace the duties and responsibilities of other parties such as Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, Owners, operators, charterers, underwriters, sellers or intended buyers of a Ship or other product or system surveyed.

These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them, nor do they confer on such parties any right, claim or cause of action against the Society. With particular regard to the duties of the ship Owner, the Services undertaken by the Society do not relieve the Owner of his duty to ensure proper maintenance of the Ship and ensure seaworthiness at all times. Likewise, the Rules, surveys performed, reports, certificates and other documents issued by the Society are intended neither to guarantee the buyers of the Ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction.

In no case, therefore, shall the Society assume the obligations incumbent upon the above-mentioned parties, even when it is consulted in connection with matters not covered by its Rules or other documents.

In consideration of the above, the Interested Party undertakes to relieve and hold harmless the Society from any third party claim, as well as from any liability in relation to the latter concerning the Services rendered.

Insofar as they are not expressly provided for in these General Conditions, the duties and responsibilities of the Owner and Interested Parties with respect to the services rendered by the Society are described in the Rules applicable to the specific Service rendered.

Article 4

4.1. Any request for the Society's Services shall be submitted in writing and signed by or on behalf of the Interested Party. Such a request will be considered irrevocable as soon as received by the Society and shall entail acceptance by the applicant of all relevant requirements of the Rules, including these General Conditions. Upon acceptance of the written request by the Society, a contract between the Society and the Interested Party is entered into, which is regulated by the present General Conditions.

4.2. In consideration of the Services rendered by the Society, the Interested Party and the person requesting the service shall be jointly liable for the payment of the relevant fees, even if the service is not concluded for any cause not pertaining to the Society. In the latter case, the Society shall not be held liable for non-fulfilment or partial fulfilment of the Services requested. In the event of late payment, interest at the legal current rate increased by 1.5% may be demanded.

4.3. The contract for the classification of a Ship or for other Services may be terminated and any certificates revoked at the request of one of the parties, subject to at least 30 days' notice to be given in writing. Failure to pay, even in part, the fees due for Services carried out by the Society will entitle the Society to immediately terminate the contract and suspend the Services.

For every termination of the contract, the fees for the activities performed until the time of the termination shall be owed to the Society as well as the expenses incurred in view of activities already programmed; this is without prejudice to the right to compensation due to the Society as a consequence of the termination.

With particular reference to Ship classification and certification, unless decided otherwise by the Society, termination of the contract implies that the assignment of class to a Ship is withheld or, if already assigned, that it is suspended or withdrawn; any statutory certificates issued by the Society will be withdrawn in those cases where provided for by agreements between the Society and the flag State.

Article 5

5.1. In providing the Services, as well as other correlated information or advice, the Society, its Surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see art. 2.4), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Express and implied warranties are specifically disclaimed.

Therefore, except as provided for in paragraph 5.2 below, and also in the case of activities carried out by delegation of Governments, neither the Society nor any of its Surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the Services.

5.2. Notwithstanding the provisions in paragraph 5.1 above, should any user of the Society's Services prove that he has suffered a loss or damage due to any negligent act or omission of the Society, its Surveyors, servants or agents, then the Society will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific services, information or opinions from which the loss or damage derives or, if no fee has been charged, a maximum of AED5,000 (Arab Emirates Dirhams Five Thousand only). Where the fees charged are related to a number of Services, the amount of the fees will be apportioned for the purpose of the calculation of the maximum compensation, by reference to the estimated time involved in the performance of the Service from which the damage or loss derives. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by the Society will not be more than AED5,000,000 (Arab Emirates Dirhams Five Millions only). Payment of compensation under this paragraph will not entail any admission of responsibility and/or liability by the Society and will be made without prejudice to the disclaimer clause contained in paragraph 5.1 above.

5.3. Any claim for loss or damage of whatever nature by virtue of the provisions set forth herein shall be made to the Society in writing, within the shorter of the following periods: (i) THREE (3) MONTHS from the date on which the Services were performed, or (ii) THREE (3) MONTHS from the date on which the damage was discovered. Failure to comply with the above deadline will constitute an absolute bar to the pursuit of such a claim against the Society.

Article 6

6.1. These General Conditions shall be governed by and construed in accordance with United Arab Emirates (UAE) law, and any dispute arising from or in connection with the Rules or with the Services of the Society, including any issues concerning responsibility, liability or limitations of liability of the Society, shall be determined in accordance with UAE law. The courts of the Dubai International Financial Centre (DIFC) shall have exclusive jurisdiction in relation to any claim or dispute which may arise out of or in connection with the Rules or with the Services of the Society.

6.2. However,

(i) In cases where neither the claim nor any counterclaim exceeds the sum of AED300,000 (Arab Emirates Dirhams Three Hundred Thousand) the dispute shall be referred to the jurisdiction of the DIFC Small Claims Tribunal; and

(ii) for disputes concerning non-payment of the fees and/or expenses due to the Society for services, the Society shall have the

right to submit any claim to the jurisdiction of the Courts of the place where the registered or operating office of the Interested Party or of the applicant who requested the Service is located.
In the case of actions taken against the Society by a third party before a public Court, the Society shall also have the right to summon the Interested Party or the subject who requested the Service before that Court, in order to be relieved and held harmless according to art. 3.5 above.

Article 7

7.1. All plans, specifications, documents and information provided by, issued by, or made known to the Society, in connection with the performance of its Services, will be treated as confidential and will not be made available to any other party other than the Owner without authorization of the Interested Party, except as provided for or required by any applicable international, European or domestic legislation, Charter or other IACS resolutions, or order from a competent authority. Information about the status and validity of class and statutory certificates, including transfers, changes, suspensions, withdrawals of class, recommendations/conditions of class, operating conditions or restrictions issued against classed ships and other related information, as may be required, may be published on the website or released by other means, without the prior consent of the Interested Party.
Information about the status and validity of other certificates and statements may also be published on the website or released by other means, without the prior consent of the Interested Party.

7.2. Notwithstanding the general duty of confidentiality owed by the Society to its clients in clause 7.1 above, the Society's clients hereby accept that the Society may participate in the IACS Early Warning System which requires each Classification Society to provide other involved Classification Societies with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the ship which may be the specific property of another party), to enable such useful information to be shared and used to facilitate the proper working of the IACS Early Warning System. The Society will provide its clients with written details of such information sent to the involved Classification Societies.

7.3. In the event of transfer of class, addition of a second class or withdrawal from a double/dual class, the Interested Party undertakes to provide or to permit the Society to provide the other Classification Society with all building plans and drawings, certificates, documents and information relevant to the classed unit, including its history file, as the other Classification Society may require for the purpose of classification in compliance with the applicable legislation and relative IACS Procedure. It is the Owner's duty to ensure that, whenever required, the consent of the builder is obtained with regard to the provision of plans and drawings to the new Society, either by way of appropriate stipulation in the building contract or by other agreement.
In the event that the ownership of the ship, product or system subject to certification is transferred to a new subject, the latter shall have the right to access all pertinent drawings, specifications, documents or information issued by the Society or which has come to the knowledge of the Society while carrying out its Services, even if related to a period prior to transfer of ownership.

Article 8

8.1. Should any part of these General Conditions be declared invalid, this will not affect the validity of the remaining provisions.

EXPLANATORY NOTE

1. **Reference edition**

   The reference edition for Part B is this edition effective from 15th August 2015.

2. **New editions after the reference edition**

   Except in particular cases, a new edition of the Rules is published annually.

3. **Effective date of the requirements**

   3.1 All requirements in which new or amended provisions with respect to those contained in the reference edition have been introduced are followed by a date shown in brackets.

   3.2 The date shown in brackets is the effective date of entry into force of the requirements as amended by the last updating. The effective date of all those requirements not followed by any date shown in brackets is that of the reference edition.

4. **Rule Variations and Corrigenda**

   Until the next edition of the Rules is published, Rule Variations and/or corrigenda, as necessary, will be published on the TASNEEF web site (www.tasneef.ae). Except in particular cases, paper copies of Rule Variations or corrigenda are not issued.

6. **Summary of amendments introduced in the edition effective from 15th August 2015.**

   This edition of the Rules for the classification of Ships is considered as a reference edition for future amendments

RULES FOR THE CLASSIFICATION OF STEEL FIXED OFFSHORE PLATFORMS

RULES FOR THE CLASSIFICATION OF STEEL FIXED OFFSHORE PLATFORMS

Part A

Chapters **1 2 3**

CHAPTER 1 APPLICATION AND GENERAL

1 Application

1.1 Regulatory framework

1.1.1 Oil and gas exploration and production activities in given geographical regions ((which can form all or part of the offshore waters of one or more countries) are governed by local legislation or National Acts, whose compliance is to be considered mandatory and under the responsibility of the platform's Owner, besides the provisions of these Rules or any mentioned reference International Standard

1.1.2 The regulatory framework, including regulatory requirements or specific legislation to be applied, shall be considered of primary importance when covering similar technical or safety issues subject of provisions in these Rules.

Relevant provisions are to be included in project design premises to be submitted to Tasneef at the beginning of the required third party service described in Chapter 2.

In general, the project design premises are to set additional requirements for fixed steel offshore structures applicable to particular geographical regions, as well as regional environmental conditions and local design, construction and operating practices that are not to be in conflict with the general safety target of these Rules.

1.1.3 Specifically to Europe, the European Community (EC) Countries and current members of the European Free Trade Association (EFTA) states have set bilateral agreements to be linked in the European Union's internal market, EEA (European Economic Area).

Common requirements are set by the EC, to be then implemented by each of the EC members through their own law making process. Under the EEA agreement, EFTA countries have agreed to meet the requirements of directives agreed upon by the EC, which are including directives relating to safety and relieving of trade barriers.

The EU Directive (2013/30/EU) on safety of offshore oil and gas operations issued on 2013, 28th of June, states that member states bordering offshore waters will have two years to transpose the directive into national legislation in force, to be applied for existing and future offshore installations and operations.

1.1.4 The EU Directive (2013/30/EU) includes provisions for Independent verification, to be established by operators and owners according to Article 17 of the Directive. The independent verification requires the development of a risk-based safety-case assessment, covering the information specified in Enclosure I, Part 5 of the Directive.

1.2 Type of service

1.2.1 These Rules apply to classification, certification or independent verification of steel fixed offshore platforms depending on the approach chosen by the platform's owner according to the scheme defined in Part A Chapter 2 of these Rules.

1.3 Type of platform

1.3.1 The platforms dealt with by these Rules are specifically those consisting of one tubular frame structure (jacket) supporting one or more decks on which the intended industrial operations (drilling, hydrocarbon production, etc.) are carried out, or which are used for accommodation, meteorological and oceanographic stations etc.

Besides jackets, the type of supporting structures covered by these Rules are also steel caissons, free-standing or braced, monopodes and towers or other bottom founded structures to the extent that reported requirements are relevant.

Such platforms may be pile supported or gravity based on the sea bed.

1.3.2 The Rules do not apply to non-safety-related components or systems and to those components which are not essential for global integrity of the platform.

1.3.3 Novel technologies not covered by these Rules will be subjected to special considerations (e.g. through an ad-hoc Technology Qualification, according to the "Tasneef Guide for Technology Qualification Processes" 2014).

2 General

2.1 Amendments to the rules

2.1.1 Amendments to the Rule requirements may be made at any time and may also be applicable to maintain an existing platform's certification.

Applications of the amendments to existing platform's certification will be limited to those cases deemed necessary or reasonable and practicable at the discretion of Tasneef.

Where the application of the amendments to existing platform's certification requires a new analysis and additional stiffeners or safety measures or structural stiffeners, this will be clearly specified in the same amendments.

2.1.2 Taking into account that the design technology of offshore platforms is not only a complex technology but is rapidly evolving, these Rules will be subject to review and updating as deemed necessary based both on experience and on future development.

2.2 Governmental rules

2.2.1 Either the certification or the classification of a fixed offshore platform with Tasneef or, more generally, any Tasneef act and decision does not relieve the interested parties from their duty of complying with any additional and/or more stringent requirements issued by the competent Administration and the relevant provisions for this application.

2.2.2 In particular, holders of authorisations for offshore oil and gas operations pursuant to Directive 94/22/EC are to comply with Directive 2013/30/EU on safety of offshore oil and gas operations. In this view, Tasneef may act as independent verifier according to Article 17 of aforesaid 2013/30/EU.

2.3 Compliance with other rules

2.3.1 For matters not expressly specified or modified by these Rules, the requirements of the relevant Chapters of the "Rules for the Construction and Classification of Mobile Offshore Drilling Units and Other Similar Units" and those of the "Rules for the Classification of Ships" (hereafter referred to simply as "Tasneef Rules" or "Rules") are to be complied with, if applicable.

2.4 Alternative design criteria

2.4.1 Tasneef reserves the right to accept design criteria alternative to those mentioned in this Rules, provided it is satisfied that equivalent safety is achieved by such criteria.

2.5 Recognized International Standards

2.5.1 Since ISO (The International Standard Organisation) have released a suite of International Standards (in some cases amended as National Standards by member bodies such as UNI), namely the ISO 19900 series, for offshore structures, the application of the following standards is considered ensuring the achievement of appropriate reliability levels for manned and unmanned platforms, therefore generally applicable, in conjunction with specific guideline and additional provisions provided by these Rules.

- ISO 19900, Petroleum and natural gas industries — General requirements for offshore structures
- ISO 19901-1, Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating considerations
- ISO 19901-2, Petroleum and natural gas industries — Specific requirements for offshore structures — Part 2: Seismic design procedures and criteria
- ISO 19901-3, Petroleum and natural gas industries — Specific requirements for offshore structures — Part 3: Topsides structure
- ISO 19901-4, Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations
- ISO 19901-5, Petroleum and natural gas industries — Specific requirements for offshore structures — Part 5: Weight control during engineering and construction
- ISO 19901-6, Petroleum and natural gas industries — Specific requirements for offshore structures — Part 6: Marine operations
- ISO 19902, Petroleum and natural gas industries — Fixed steel offshore structures
- EN 13852:2013 - Offshore cranes.

2.6 Assumptions

2.6.1 The Rules are based on the assumption that the structure is designed by qualified designers and built by qualified manufacturers and that the platform is properly operated by skilled personnel under the responsibility of the owner.

The Rules also assume that the actual operating conditions do not differ substantially from those for which the platform is designed.

2.7 Definitions

2.7.1 General

In these Rules general reference is made to terms and definitions reported in Clause 3 of ISO 19902:2007.

2.7.2 Specific indications on the Certificate

In addition to the definitions introduced in § 2.7.1, the following ones are also applied, and possible subject of specific indication on the Certificate issued by Tasneef (e.g. on the Certificate it will be specified whether the platform is "manned" or "unmanned").

Manned platform

A platform designed to be operated by persons continuously accommodated and living thereon.

Design life

The period of time between the commencement of construction and removal or breaking-up of the platform, which is subdivided into the following phases:

I construction phase:
this phase includes construction and assembly of the platform ashore or afloat;

II transportation phase:
this phase includes transportation of the platform or parts thereof, from the construction site to its final location including its possible loading on barges and mooring operations on the final location;

III installation phase:
this phase includes possible operations of launching, upending, submerging and positioning, piling, anchoring, ballasting, arrangements of decks and/or modular components, etc. until the platform is ready to start its normal service operation;

IV operation phase:
this phase starts with completion of installation and ends with removal or breaking-up of the platform;

V removal phase:
this phase includes removal of the platform from its location at the end of its operation phase.

Location

The geographical location where the platform is finally installed to perform its design operation.

Water depth

The vertical distance from the sea bed to the minimum water level taking into account the effects, combined as necessary, of astronomical, wind and pressure differential tides.

Design service

Industrial services (drilling, hydrocarbon production, etc.) or similar operations (accommodation, oceanographic and meteorological station, etc.) for which the platform is designed and which it will perform.

Owner

The Owner of the platform or parts thereof or the operator who conducts the operations and takes upon himself the consequent duties and responsibility.

2.7.3 Definitions for process and safety issues

Being the mentioned ISO related to the structural part of the platform only, while these Rules are also addressing the process part, the following definitions are introduced to be eventually used when reading the Part C of these Rules.

- **PFD:** Process Flow Diagram with Heat and Material Balance.
- **P&ID:** Piping and Instrument Diagram.
- **ESD:** Emergency Shut-Down is to be provided against hazardous events.
- **Technical Data Sheet:** data for the process design of pressure vessels, heat exchangers, atmospheric tanks, instrumentations and control system.
- **Mechanical Data Sheet:** data for the mechanical design of pressure vessels, heat exchangers, atmospheric tanks.
- **Safety Critical Device:** a device or system is considered safety critical if it is the last line of defence to prevent an uncontrolled major breach of containment, severe personal injury or death or a major environmental incident, or is otherwise essential in the control or mitigation of such incident. Typical items are: PRV: Pressure Relief Valve, RD: Rupture Disk, Check Valves, EBV: Emergency Block Valve.
- **Safety Integrity Level (SIL):** discrete level (one out of four) for specifying the safety integrity requirements of the safety instrumented functions to be allocated to the safety instrumented systems. Safety integrity level 4 has the highest level of safety integrity; level 1 has the lowest.
- **Emergency Shut Down (ESD)** and relevant inclusions (e.g. UPS Uninterruptible Power Supply),
- **Reid Vapour Pressure (RVP):** a vapour pressure of a liquid at 100°F (37.8 °C), determined by a standard laboratory procedure (ASTM Test D-323), expressed in psa
- **Risk:** the combination of a probability of an abnormal event of failure and the consequences of that event on worker, the community and the plant.
- **High Integrity Protective System (HIPS):** an arrangement of instruments and other equipment, including sensors, logic controllers and final control elements used to isolate or remove a source of pressure from a system or to trip or shut-down or depressurizing device such that the design pressure and/or temperature of the protected system will not be exceeded.
- **Hazard:** a chemical or physical condition that has the potential for causing harm to people, property or the environment.
- **Corrosive Hydrocarbons:** hydrocarbon containing contaminants (e.g. HCl, H2S, ammonia and other impurity, oxygen, strong caustics and acids).

- **Auto- ignition temperature (AIT):** is the lowest temperature required to cause self-sustaining combustion, without initiation by spark or flame.
- **BLEVE (Boiling Liquid Expanding Vapour Expansion):** is the acronym for a Boiling Liquid Expanding Vapour Explosion. This type of explosion occurs if a vessel containing superheated hydrocarbon liquid fails catastrophically when fire exposure results in overheating and yielding of a pressure vessel.
- **Contingency:** is an abnormal event which causes an emergency.
- **Critical Expansion Temperature (CET):** is defined as the lowest metal temperature for which the equipment are to be designed.
- **Deflagration:** is an explosion in which the burning process of the flammable mixture (vapour or dust9 is governed by heat and mass transfer.
- **Detonation:** is a high severity explosion with the propagating flame front travels as a supersonic shock wave that is closely followed by a combustion zone which releases the energy needed to maintain the shock wave.
- **Emergency**: is an interruption from normal operation in which personnel, equipment, or the environment may be endangered or harmed in some manner.
- **Exposure Limits**: occupational exposure limits are used for evaluating exposure to toxic hazards and assessing the potential need for control.
- **Threshold Limit Value - Time Weighted Average (TLV-TWA):** the time weighted average concentration for a conventional 8-hour workday and 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.
- **Threshold Limit Value – Short Term Exposure Limits (TLV-STEL):** the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from: irritation, chronic or irreversible tissue damage or narcosis of sufficient degree to increase the likelihood to accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded.
- **Threshold Limit Value Ceiling (TLV-C):** the concentration that should not exceeded during any part of the working exposure.
- **Flammable or Explosive Limits:** are limits are the minimum concentrations (expressed as volume fraction or %) of a flammable vapour (or aerosol/mist) in air which is capable of supporting combustion.
- **Flash Point:** is the lower temperature at which a level exposure to the air gives off sufficient vapour to form a flammable mixture near the surface of the liquid, or within the test apparatus used, which can be ignited by a suitable flame.
- **Mothballing procedure:** procedure for short or long term plant shut-down.
- **Light end:** are volatile flammable liquids which are significantly vaporized at normal ambient conditions.
- **Pyrophoric Material:** material that rapidly oxide when exposed to air and which may incandesce, thus forming a source of ignition.

CHAPTER 2 CLASSIFICATION CERTIFICATION AND INDEPENDENT VERIFICATION

1 Foreword

1.1 Third party role

1.1.1 According to these Rules, platform designers and operators can choose and mix from the different three schemes inherent possible third party services for fixed offshore platforms:

- Classification;
- Certification;
- Independent Verification.

1.1.2 The wording "Classification of the platform", as used in these Rules, means that the platform has been designed, constructed, installed and maintained in compliance with these requirements.

1.1.3 The maintenance of class is subject to fulfilment of the provisions of these Rules concerning surveys after construction and maintenance during the service life.

1.1.4 The wording 'Certification' as used in these Rules, means that an item such as a system, equipment, structure etc. is designed, constructed and installed in compliance with these Rules or other specified regulations.

1.1.5 The wording 'Independent Verification' means that Tasneef is asked to act as independent verifier, as per Article 17 of Directive 2013/30/EU. In this role, the scheme of independent verification may refer to the application of these Rules or other applicable Codes and Standards adopted by the relevant operators and owners.

2 Classification

2.1 Certificate of Classification: issue, validity, endorsement and renewal

2.1.1 Issue of Certificate of Classification

A Certificate of Classification, bearing the class notations assigned to the platform and an expiry date, is issued to any classed platform.

A Provisional Certificate of Classification may serve as a Certificate of Classification in some cases, such as after an admission to class survey, or when Tasneef deems it necessary.

The Certificate of Classification or Provisional Certificate of Classification is to be made available to Tasneef Surveyors upon request.

2.1.2 Validity of Certificate of Classification, maintenance of class

Tasneef alone is qualified to decide upon the meaning, interpretation and application of the Rules and other classification-related documents. No reference to the Rules or other classification-related documents has any value unless it involves, accompanies or follows the intervention of Tasneef alone is qualified to confirm the class of the platform and the validity of its Certificate of Classification.

During the class period, a Certificate of Classification is valid when it is not expired.

The class is maintained during a certain period or at a given date, when during the said period or at such date the conditions for suspension or withdrawal of class are not met.

At the request of the Owner/operator, a statement confirming the maintenance of class may be issued by Tasneef based on the information in its records for that platform at the time.

This statement is issued on the assumption that the Owner has complied with the Rules, in particular with Chapter 3, [12].

Should any information which would have prevented Tasneef from issuing the statement and which was not available at the time subsequently come to light, the statement may be cancelled.

Attention is drawn to [2.5], whereby Tasneef, upon becoming aware of a breach of the Rules, is empowered to suspend class from the date of the breach, which may be prior to the date of the statement.

According to the same conditions as in [2.1.2], a statement declaring that the class is maintained "clean and free from recommendation'' may be issued by Tasneef when there is no pending recommendation at that date.

Classification-related documents and information are liable to be invalidated by Tasneef whenever their object is found to differ from that on which they were based or to be contrary to the applicable requirements. The Owner is liable for any damage which may be caused to any third party from improper use of such documents and information.

2.1.3 Endorsements of Class

a) Purpose of endorsements

The endorsements of class give official evidence of:

1) class surveys carried out,
2) class validity, and
3) conditions imposed and/or main items out of service (if any).

b) Direct endorsement of the Certificate of Classification

The Certificate of Classification is directly endorsed before the platform operates where an annual or class renewal survey is completed, using the appropriate section of the Certificate of Classification.

A section is also available to record postponement of the class renewal survey.

.c) Class Survey Endorsement Sheet

In addition to the direct endorsement of the Certificate of Classification as described in [2.1.3.b], a Class Survey Endorsement Sheet is issued before the platform operates where any class survey is carried out.

The Class Survey Endorsement Sheet is an attachment to the Certificate of Classification and, as such, it is to be available on board at any time.

d) Possible modifications to endorsements

Tasneef reserves the right to modify the endorsements made by Surveyors.

2.1.4 Status of surveys and recommendations

Information given in the Certificate of Classification, associated endorsements, Rules and specific documents enables the Owner to identify the status of surveys and recommendations.

The omission of such information does not absolve the Owner from ensuring that surveys are held by the limit dates and pending recommendations are cleared to avoid any inconvenience which is liable to result from the suspension or withdrawal of class, see [2.5] and [2.6] respectively.

2.2 Classification tasks

The classification of a platform may cover, upon request by the Client, structures, process plant facilities and/or accommodations and living quarters

2.2.1 Structures

The classification of the structure covers:

a) materials;

b) structural strength;

c) foundations;

d) helicopter deck (if any);

e) corrosion protection system;

f) accommodation modules.

The structures of the accommodation modules, in view of their similarity to civil buildings in terms of function and loads, may be designed according to the civil building regulations applicable in the coastal areas where the platform is installed offshore.

2.2.2 Process plant facilities

The classification of the process plant facilities covers, as a minimum;

a) safety philosophy adopted in the design;

b) systems, equipment and their supporting structures used for hydrocarbon production and processing;

c) equipment and systems used for operations;

d) safety-related systems.

Operational issues are normally outside the scope of classification, except for the safety management issues which are to be complied with according to local rules and regulations.

Performance and production aspects are outside the scope of classification, unless explicitly required by the Client.

The safety criteria set forth in these Rules may be integrated by the results of the safety case of the facility.

2.2.3 Accommodations and living quarters

The classification of accommodations and living quarters will be carried out according to the requirements of the local authorities.

2.3 Assignment of class

The classification of a platform may cover, upon request by the Client, structures, process plant facilities and/or accommodations and living quarters

2.3.1 Issue of relevant certification

When the platform is designed, constructed, installed and surveyed according to these Rules, a Certificate of Classification for steel fixed offshore platforms is issued, covering the condition of use of the platform and containing:

a) a description of the platform as installed and its design operation;

b) a statement certifying that the platform has been designed, constructed and installed as required by these Rules and under the supervision of Tasneef.

2.3.2 Class notations

The class notation "**Fixed platform**" is assigned (see Part A, Chapter 1, Section 2 of Tasneef Rules) to steel fixed offshore platforms assigned with a Certificate of Classification.

Platforms constructed and installed under the supervision of Tasneef (see Chapter 3, [2.2]) will also be assigned the supervision mark Maltese Cross (✠).

2.3.3 Service notations

The class notations define the type and/or service of the platform which has been considered for its classification, according to the request for classification signed by the Interested Parties.

2.3.4 Additional Class notations

An additional class notation expresses the classification of additional equipment or specific arrangement, which has been requested by the Interested Parties.

2.3.5 Validity of the Certificate of Classification

The Certificate of Classification is issued for a validity period which normally does not exceed five years and may be renewed upon satisfactory completion of the relevant class renewal survey (see Chapter 3, [5] and [6]).

2.3.6 Discontinuance of class

The class may be discontinued either temporarily or permanently. In the former case, it is referred to as "suspension" of class, in the latter case as "withdrawal" of class. In both cases, the class is invalidated in all respects. In the case of withdrawal, a specific notation is entered in the supplement to the Register of Platforms, until the platform is deleted from the Register. Withdrawal, suspension and reinstating of class are confirmed in writing by Tasneef to the Owner and to the interested Administration authorities, if relevant.

2.4 Maintenance of class

2.4.1 General

The maintenance of the class requires that both the structure and the topside are subjected to appropriate surveys, as specified in Chapter 3.

2.5 Suspension of class

2.5.1 General

The class may be suspended either automatically or following the decision of Tasneef. In any event, the platform will be considered as not retaining its class from the date of suspension until the date when class is reinstated.

Class is automatically suspended when one or more of the following circumstances occur:

- when a platform is not operated in compliance with the rule requirements, such as in cases of services or conditions outside the restrictions for which class was assigned;
- when the Owner fails to inform Tasneef in order to submit the platform to a survey after defects or damages affecting class have been detected;
- when repairs, alterations or modifications affecting class are carried out either without requesting the attendance of Tasneef or not to the satisfaction of the Surveyor.

Suspension of class with respect to the above cases will remain in effect until such time as the cause giving rise to suspension has been removed. Moreover, Tasneef may require any additional surveys deemed necessary taking into account the condition of the platform and the cause of the suspension.

2.5.2 Suspension and reinstatement of class in the case of overdue class renewal survey

Owners are to be notified that the Certificate of Classification expires and classification is automatically suspended from the certificate expiry date in the event that the class renewal survey has not been completed or is not under attendance for completion prior to resuming operations, by the due date.

Classification will be reinstated upon satisfactory completion of the surveys due. The surveys to be carried out are to be based upon the survey requirements at the original date due and not on the age of the platform when the survey is carried out. Such surveys are to be credited from the date originally due.

Under "exceptional circumstances", as defined in [2.5.7], Tasneef may grant an extension not exceeding three months to allow for completion of the class renewal survey provided that the platform is attended and the attending Surveyor(s) so recommend(s) after the following have been carried out:

a) annual survey;

b) re-examination of recommendations;

c) progression of the class renewal survey as far as practicable.

2.5.3 Suspension and reinstatement of class in the case of overdue annual survey

Owners are to be notified that the Certificate of Classification becomes invalid, and classification is automatically suspended, if the annual survey has not been completed within three (3) months of the due date of the annual survey, unless the platform is under attendance for completion of the annual survey.

Classification will be reinstated upon satisfactory completion of the surveys due. Such surveys are to be credited from the date originally due.

2.5.4 Suspension of class in the case of overdue continuous survey item(s)

Continuous survey item(s) due or overdue at the time of the annual survey is (are) to be dealt with. The platform's class will be subject to a suspension procedure if the item(s) is (are) not surveyed, or postponed by agreement.

2.5.5 Other cases of suspension of class

In addition to the circumstances for which automatic suspension may apply, the class of a platform may also be suspended following the decision of Tasneef:

- when one or more surveys are not held by their limit dates, or the dates stipulated by Tasneef also taking into account any extensions granted in accordance with the provisions of Part A;
- when, due to reported defects, Tasneef considers that a platform is not entitled to retain its class even on a temporary basis (pending necessary repairs or renewals, etc.);
- in other circumstances which Tasneef will consider on their merits (e.g. in the event of non-payment of fees or where the Owner fails to subject the platform to the occasional survey as per the requirement in Chapter 3, [12]).

Suspension of class decided by RINA takes effect from the date when the conditions for suspension of class are met and will remain in effect until such time as the class is reinstated once the due items and/or surveys have been dealt with.

2.5.6 Mothballed platforms

Mothballed platforms in accordance with the requirements indicated in Chapter 3, [16] prior to surveys becoming overdue need not be suspended when surveys addressed above become overdue. However, platforms which are mothballed after being suspended as a result of surveys going overdue, remain suspended until the overdue surveys are completed.

2.5.7 Exceptional circumstances

'Exceptional circumstances' means unavailability of repair facilities, unavailability of essential materials, equipment or spare parts, or delays incurred by action taken to avoid severe weather conditions.

2.5.8 Force Majeure

If, due to circumstances beyond the Owner's or Tasneef control ('Force Majeure') as defined below:

- damage to the platform;
- unforeseen inability of Tasneef to attend the platform due to government restrictions on right of access or movement of personnel;
- unforeseeable delays in port or inability to discharge cargo due to unusually lengthy periods of severe weather, strikes or civil strife;
- acts of war;
- or other force majeure,

the platform is not in conditions where the overdue surveys can be completed at the expiry of the periods allowed above, Tasneef may allow the platform to operate, in class, until the first occasion at which the survey can be completed, provided RINA:

a) examines the platform's records;

b) carries out the due and/or overdue surveys and examination of recommendations at the first occasion when there is unforeseen inability of Tasneef to attend the platform, and

c) has satisfied itself that the platform is in condition to operate for a reasonably short period until the first occasion of survey or repair, if necessary.

The surveys to be carried out are to be based upon the survey requirements at the original date due and not on the age of the platform when the survey is carried out. Such surveys are to be credited from the date originally due.

If class has already been automatically suspended in such cases, it may be reinstated subject to the conditions prescribed in this item.

2.5.9 Suspension and reinstatement of class in the case of overdue recommendations

Each recommendation will be assigned a due date for completion. Owners will be notified of these dates and that the platform's class will be subject to a suspension procedure if the item is not dealt with, or postponed by agreement, by the due date.

Classification will be reinstated upon verification that the overdue recommendation has been satisfactorily dealt with.

2.6 Withdrawal of class

2.6.1 Tasneef may withdraw the Certificate of Classification in the following cases:

a) when the platform is subjected to repairs, alterations or conversions affecting components of primary importance for the whole integrity of the structure or safety-related systems of the topside without the Owner requesting Tasneef survey;

b) when a class condition or a request for checks to be regarded as a class condition is not complied with by the specified deadline;

c) when one or more periodical surveys are not held by the deadline of the extension allowed by Tasneef;

d) when defects are detected such that Tasneef considers that the platform is not entitled to retain its class even on a temporary basis (i.e. pending necessary repairs or renewals);

e) when during its operation phase the platform is subjected to service loads higher than the maximum approved design loads;

f) at the request of the Owner.

2.6.2 Withdrawal of class takes effect from the date on which the circumstances causing such withdrawal occur.

2.6.3 When class is withdrawn from a platform, Tasneef will make arrangements to:

- send notice in writing to the Owner;
- inform the competent Administration;
- make available the relevant information to the insurers, at their request.

2.7 Reassignment of class following class withdrawal

2.7.1 At the request of the Owner, a platform which was previously classed with Tasneef, subsequently withdrawn from class and that has not been further classed i.e.

- has never resumed its operations;
- has not been classified by any other Classification Society

may have the class reassigned.

2.7.2 The reassignment of Class may take place upon satisfactory:

- removal of the causes that led to class withdrawal;
- execution of the surveys expired during the period of class withdrawal;
- verification of additional issues as deemed necessary by Tasneef according to the provisions of Class renewal survey General principles set forth in Chapter 3, [5] and [6].

The new period of Class and the validity of the Certificate of Classification will be considered by Tasneef on a case by case basis.

2.8 Documentation for classification

2.8.1 Documentation relevant to the classification is to be submitted for the approval of Tasneef.

2.8.2 The design data, calculations and plans to be submitted are specifically listed in Section B, Chapter 1, and Section C, Chapter 1, of these Rules as regards to structures and topside process respectively.

Tasneef may also call for additional information according to the specific nature of the platform to be classed.

The documentation requested in relevant Chapters of these Rules in hard copy may, as an alternative, be submitted in electronic format to be agreed with Tasneef.

2.8.3 The documentation submitted to Tasneef is examined in relation to the class applied for in the request for classification.

Note 1: Should the Interested Party subsequently wish to have the Class granted to the platform modified, plans and drawings are generally to be re-examined.

2.8.4 A copy of the submitted plans will be returned duly stamped (meaning 'stamp' the evidence of the completion of Tasneef examination and relevant result, with remarks related to the compliance with the rule requirements should the need arise. Such a stamp may be reported in electronic format if relevant documentation has been submitted in electronic format, see [2.8.2]).

2.8.5 As a rule, modifications of the approved plans regarding items covered by classification are to be submitted.

2.8.6 Design data to be submitted to Tasneef are to incorporate all information necessary for the assessment of the design of the platform for the purpose of assignment of class.

It is the responsibility of the Interested Party to ascertain that the design data are correct, complete and compatible with the use of the platform.

2.8.7 Design calculations are to be provided, when asked for, as supporting documents to the submitted plans.

2.8.8 Design data and calculations are to be adequately referenced. It is the duty of the Interested Party to ascertain that the references used are correct, complete and applicable to the design of the platform.

2.8.9 The submitted plans are to contain all necessary information for checking the compliance with the requirements of the Rules.

2.8.10 In the case of conflicting information, submitted documentation will be considered in the following order of precedence: design data, plans, design calculations.

2.8.11 It is the responsibility of the Interested Party to ascertain that drawings used for the procurement, construction and other works are in accordance with the approved plans.

2.9 Operating manual

2.9.1 In case that the classification of the platform is required, an Operating Manual (including safety management system documentation as applicable, see [2.2.2]) containing all information, to the satisfaction of Tasneef, which are necessary for the safe operation of the platform under normal and emergency conditions is to be prepared, kept on board and made available to all authorised personnel.

2.9.2 The Operating Manual is to be submitted to Tasneef in its entirety for consideration; however, the only sections of the Manual subject to approval are those which concern operational procedures considered in the design or which may affect the verifications required in these Rules.

Subject to the above, the operational procedures are not covered by the classification.

2.9.3 The Operating Manual is to include the following information when applicable:

a) a general description of the platform including dimensions of all protrusions;

b) values of factors defining allowable severe environmental conditions;

c) general arrangement plans showing allowable loadings on decks;

d) instructions for operation of the platform including the operations to be carried out to enable it to withstand the most severe environmental working conditions for its service;

e) some significant examples of loading conditions;

f) conditions relevant to seasonal restrictions for platform operations, if any;

g) identification and characteristics of the helicopter used for the design of the helicopter deck, if any;

h) all the information needed to run the unit safely under normal and emergency conditions, i.e. at least the following:

1) instructions for the safe operation of the platform in all envisaged normal and emergency conditions;

2) the values of the parameters which establish the maximum assumed environmental conditions to determine the loads acting on the structure and its operability;

3) schematic diagram of the electrical installations and the relative electric balance of the main and emergency source of electrical power and of the emergency batteries;

4) emergency shutdown (ESD) principles and procedures;

5) emergency procedures;

6) black-out management procedure;

7) schematic diagram of the main systems for off-loading and storing the oil fuel;

8) schematic diagram of the inert gas systems;

9) schematic diagram of systems to detect toxic and/or flammable mixtures;

10) schematic diagrams of hydrocarbon and/or LNG/LPG handling and processing systems, including venting systems;

11) schematic diagrams of the system for the use of hydrocarbon and/or LNG/LPG as fuel in boilers or internal combustion engines or gas-fired turbines;

12) plans of the hazardous areas;

13) plans for fire protection, including the type and position of fire detection and fire-extinguishing means;

14) schematic diagrams of depressurizing, flaring and Blowdown systems;

15) plans and instructions of well control systems;

16) escape, evacuation, rescue (EER) and communication procedures, covering at least temporary refuges, escape routes, muster stations, life-saving appliances , personal lifesaving appliances and abandonment;

17) maintenance plans;

18) instructions for the condition monitoring systems (if any);

19) the management of the risk control measures and safety-critical elements resulting from the risk assessment;

20) the program of periodical surveys and maintenance of the unit;

21) identification of the components (if any) made of materials which have uncommon welding characteristics and the recommended procedures for the relevant repairs;

22) operations of cargo handling gear and lifting appliances;

23) pollution prevention plans.

3 Certification

3.1 Foreword

3.1.1 Tasneef may act as a Third Party providing a Certification Service aimed to ensure the compliance of the design, manufacturing and construction of the whole offshore platform, or material, components, piece of equipment thereof, with these Rules as well as with international standards, project specification or other documentation applicable for the purpose.

Through the execution of the certification services described in the following Chapter 3.2, the platform's owner may ask Tasneef to perform one or more tasks from the described ones, up to cover all the phases of a platform's project, including:

- Feasibility design;
- Front end engineering design;
- Detailed design;
- Manufacturing of materials;
- Supply of equipment;
- Fabrication;
- Installation;
- Life extension.

3.1.2 At the completion of the service, a final certification document will be issued, which, according to the scope of work agreed upon the Parties (i.e. the platform's Owner and Tasneef), may be referred as Certificate of Conformity, Test Certificate, Certificate of Compliance, etc.

The final Certificate is to address the following basic contents:

- Platform's owner or contractor's name;
- Item (s) subject of certification;
- Applicable regulation, standards and specification;
- Certification tasks performed;

  performed, where applicable, traceability information, approved project documents, tests
- List of the enclosures, etc.;

in addition to other statements and information relevant to the outcomes of the certification activities deemed necessary by Tasneef or specifically required by the owner, and agreed by the interested Parties, on a case-by-case basis .

3.2 Certification tasks

3.2.1 Certification tasks for a new platform

The term "Certification" is used as covering one or more of the following tasks relevant to the realization of a new platform:

- Certification of the project,

  where a specific appraisal activity is performed by Tasneef on the design documentation relevant to the project of a fixed offshore platform, in order to verify and possibly certify the compliance of that design with these Rules and/or other design standards and project requirements, if applicable;
- Construction survey,

  where long term survey services, involving Tasneef personnel mobilized to construction sites, are carried out to verify and ensure that the fabrication of the offshore platform, or components thereof, is compliant with the approved design documents and applicable specifications for construction; long term survey means that the required Tasneef supervision of the different items relevant to the platform's construction is to be performed by field surveyor(s) on the basis of a Quality Control Plan, see [3.5.2], agreed between the parties and covering the fabrication schedule.
- Vendor Inspection, expediting and auditing services,

  where short term activities, involving Tasneef personnel mobilized to supplier or vendor premises, are carried out to verify and ensure the compliance of materials, components and equipment with the technical requirements of the project.
- Certification of the marine operations,

  where the purpose of Tasneef is to ensure that the operations relevant to mobilization of the construction yard, sea transportation and final offshore installation of the platform are carried out in compliance with applicable project documents and approved installation specifications and manual.

The marine operations that can be subject of certification are specifically addressed in Part E, Chapter 1, of these Rules.

The verification activities required for the certification are to be carried out through:

- Examination and approval of project documentation (drawings, specifications, manuals, etc.);
- Visits to be performed before the operation:
- Attendance during its development.

The certification is formalized through the release, in the different phases of development of the project operation, of documents' approval, inspection reports, statements of compliance and/or final certificates, as required for stating that the design, the planning and the execution of the complete offshore platform installation or a single phase thereof, has been carried out in accordance with the applicable requirements and approved procedures.

Typical examples of Certificates released during the different phases of the installation of an offshore platform are:

- Loadout Operation Approval Certificate,
- Seafastening Operation Approval Certificate;
- Transportation/ Towage Operation Approval Certificate
- Structure Installation Approval Certificate.

3.2.2 Certification tasks for an existing platform

The certification activities described in [3.2.1] are relevant to the service life of a platform, being the service life defined at design stage for a given number of years, which addresses specific design requirements such as return period of the environmental actions, fatigue and corrosion targets, etc.

For an existing platform it is possibly required to extend the service life beyond initially established lifetime, thus the certification may be also required to cover the extension life.

Besides the completion of the original design life, the assessment of an existing platform may be triggered by:

- Abnormal environmental loads, beyond the design environmental actions;
- Accidental event, such as ship collision, not foreseen at design stage;
- Change in functional loads, due to change in operating, destination, etc.;
- Renewal, removal, reuse.

The certification of the assessment of an existing platform due to such triggering factors is part of these Rules, as well as the certification of an existing platform which has never been subject to a certification process.

An existing fixed offshore platforms can be subject of certification as regards to the structural capability as well as the fitness for purpose of topside process and equipment.

Specific provisions for the assessment of existing fixed steel platforms, applicable to both sub- and topside structures, are reported in Part B Chapter 1 Section 4.

3.3 Documentation for Certification

3.3.1 Depending on the scope of work specifically required for the certification, the document subject to Tasneef appraisal are to be agreed with the platform's owner and clearly identified preliminary to the activities.

3.3.2 All the drawings or project documents describing the installation or equipment in its essential aspects, with respect to the certification scope of work, are to be provided and approved for those aspects of the drawings/documents concerning the final compliance with the applicable reference standards and safety targets.

3.4 Construction dossier

3.4.1 A construction dossier is to be made covering all the aspects of the platform construction in order to collect relevant information to be eventually the main reference for the certification of the fabrication.

3.4.2 The construction dossier is also recommended to be filed by the platform Owner, suitable for structural modifications/repair intervention possibly rising during the platform service life, as well as for extension life assessment.

The construction dossier should include the following:

a) Construction drawings as well as relevant material certificates;
b) Descriptions of welding procedures and deposited materials employed and to be employed;
c) Information relevant to performed tests and results;
d) Restrictions or prohibitions regarding repairs or modifications;
e) Relevant final installation records (such as final positioning, pile driveability records, grouting records, etc.);
f) User's manuals of topside's equipment;
g) Spare parts list.

3.5 Certification of the fabrication survey

3.5.1 In order to carry out the supervision aimed to provide the certification of the platform fabrication and/or installation in compliance with applicable drawings, specification and procedures, following to the approval of reference documents, the involvement of Tasneef Surveyor(s), mobilized to construction and/or installation sites, is required to verify and ensure the project compliance with the established safety and quality requirements.

3.5.2 Such requirements are to be included in a Quality Control Plan (QCP) describing all the fabrication/installation tasks in terms of activities to be carried out, items to be checked and tests to be performed along the construction sequences.

3.5.3 The QCP is to be prepared by the Owner, or its Contractors, and shared with Tasneef preliminary to any construction phase in order to identify the specific tasks that will be subjected to hold, witness or review activity by the Tasneef surveyor.

4 Independent Verification

4.1 General

4.1.1 In case Tasneef is asked to act as independent verifier for platforms managed by owners/operators belonging to EU member states for which Directive 2013/30/EU applies without derogations (i.e. having offshore waters and offshore oil and gas operations under their jurisdiction), the documentation is to be consistent with the requests of the scheme for independent verification submitted to the competent authority as per Article 17 of Directive 2013/30/EU.

4.1.2 In case Tasneef is asked to act as independent verifier for platforms managed by owners/operators either belonging to EU member states for which Directive 2013/30/EU applies with derogations, or not belonging to EU member states, the documentation is to be agreed with the owner/ operator.

4.1.3 If Directive 2013/30/EU applies, the Operating Manual may partially or totally coincide with the document of safety and environmental management system as per Article 19, paragraph 3 thereof.

- **Flammable or Explosive Limits:** are limits are the minimum concentrations (expressed as volume fraction of %) of a flammable vapour (or aerosol/mist) in air which is capable of supporting combustion.
- **Flash Point:** is the lower temperature at which a level exposure to the air gives off sufficient vapour to form a flammable mixture near the surface of the liquid, or within the test apparatus used, which can be ignited by a suitable flame.
- **Mothballing procedure:** procedure for short or long term plant shut-down.
- **Light end:** are volatile flammable liquids which are significantly vaporized at normal ambient conditions.
- **Pyrophoric Material:** material that rapidly oxide when exposed to air and which may incandesce, thus forming a source of ignition.

CHAPTER 3 MAINTENANCE OF CLASS

1 General

1.1 General requirements

1.1.1 The maintenance of the class requires that structures and topside are subjected to periodical surveys, as specified in [2.4], generally carried out according to a survey program approved by Tasneef for the primary purpose of ascertaining the safety of the platform.

1.1.2 The survey program may vary from case to case depending on the type of the structure.

It is assumed that the Owner carries out periodical inspections as required to maintain the structures in a safe condition.

1.1.3 Inspections of underwater structures are to be performed by qualified personnel able to carry out underwater inspections to a standard similar to that required for inspections above water.

1.1.4 Underwater inspections by means of cameras or small underwater vehicles are accepted on a case to case basis according to procedures agreed upon with Tasneef and are to be carried out with a Tasneef Surveyor in attendance.

1.1.5 Non-destructive test operators are to be qualified according to the level required for the inspection and authorized by Tasneef.

1.1.6 Underwater non-destructive test operators are required to have the following qualifications:

a) a qualification certificate for non-destructive tests issued by Tasneef;

b) extensive experience in the type of diving required;

c) a minimum of six months experience of non-destructive tests using the method concerned (exemption from this requirement may be granted if supervision by more qualified personnel is provided). The operators are also to be able to perform qualification tests arranged for the specific type of job, under real conditions and in the presence of a Tasneef Surveyor.

1.1.7 Surveyors are to be given free access at all times to the platform that is classed or being classed to carry out their interventions within the scope of assignment or maintenance of class, certification or independent verification, according to the scheme agreed with Tasneef. Interested parties are to adopt the necessary measures for the surveyors' and auditors' inspections and testing to be carried out safely. Interested parties – irrespective of the nature of the service provided by Tasneef personnel or by other parties acting on its behalf – assume, with respect to such personnel, all the responsibility of an employer for its workforce such as to meet the provisions of applicable legislation. As a rule, Tasneef personnel are to be constantly accompanied during surveys by personnel of the interested party. In case where the provisions made for safety and required access are judged by the attending Surveyor to be inadequate, the surveys of the spaces involved is not to proceed.

2 Supervision

2.1 General

2.1.1 Supervision includes all operations performed by Tasneef for the purpose of ascertaining that the platform has been constructed and installed in compliance with the requirements of these Rules. It has to be carried out on structures, process facilities and/or accommodation and living quarters, for either the classification purpose or the specific certification scope of work agreed with the Owner (see Part A, Chapter 2, [3.1.1]).

2.1.2 The supervision consists of approval of drawings, specifications and procedures, and surveys carried out during construction, transportation and installation.

2.1.3 When it is deemed necessary to record data relevant to particular loading conditions of structural members and their behaviour, Tasneef reserves the right to require suitable instrumentation.

2.2 First classification survey of platforms constructed under the supervision of Tasneef

2.2.1 The survey is carried out in the course of construction, transportation and installation for the purpose of ascertaining, in particular, that:

a) the design and scantlings of items covered by requirements of these Rules, the drawings have been approved and the required materials have been used;

b) materials and equipment of the platform have been tested according to the requirements of these Rules and comply with the relevant testing documentation;

c) workmanship, welding, tests and non-destructive examinations are carried out according to the applicable requirements of these Rules, to the satisfaction of Tasneef Surveyors and according to good practice;

d) transportation and installation phases are carried out according to the relevant operating procedures previously approved by Tasneef;

e) final tests on the platform upon completion of construction are carried out with a positive outcome to the satisfaction of Tasneef Surveyors.

2.2.2 Supervision during construction is to be carried out at the fabrication yard and/or at the premises of subcontractors of essential components, according to directions and procedures to be laid down by Tasneef. The Manufacturer is to assure free access and necessary assistance to Surveyors carrying out the inspection work.

2.3 First classification survey of platforms constructed without the supervision of Tasneef

2.3.1 In the case of platforms constructed without the supervision of Tasneef, the survey procedure and checks required for the purpose of classification will be decided by Tasneef based on criteria deemed suitable in each particular case in relation to the specific characteristics of the unit.

2.3.2 If the topside process plant facility(s) is (are) not classed, but is (are) certified by an organisation acceptable to Tasneef, the survey and maintenance records of the process plant are to be made available to the Surveyor, who is to ensure that the records are up to date with no outstanding items which could affect the safety of the platform.

2.3.3 In general, for structures, the checks mentioned in [2.3.1] will include:

a) the examination of structural plans and of any other available documents in order to verify that the stress level in the main structural members is not higher than that required by these Rules;

b) the examination of available construction documents in order to check, as far as practicable, that the construction phase complies with the applicable requirements of these Rules;

c) non-destructive examinations of parts above and below the sea surface, in order to check the conditions of structures. The evaluation of the above members will be performed on the basis of global equivalence criteria rather than of detailed compliance and will take account, as far as practicable, of any available information relevant to the strength of the unit.

2.4 Supervision during operation

2.4.1 Structural supervision

For the maintenance of the Certificate of Classification, the Owner is to subject the platform to periodical surveys and inspections according to the requirements of [1.1] and according to the frequency indicated in Table 1, applicable for the structural checks.

The scheduling reported in Table 1 can be revised and submitted to Tasneef for approval on the basis of a rational approach capable to appropriately reflect the specific timing of required interventions and surveys in order to maintain the platform with the required safety target. That can be done, with respect to the fatigue issue in particular, by adopting a reliability based inspection plan.

The same requirements can be adopted for the maintenance of the structural design or extension life certification of the platform's structure.

Table 1–

Table 1 Structural surveys

TYPE OF SURVEY	NORMALLY DUE (see Note 1)
SURVEY FOR THE PURPOSE OF ISSUING THE CERTIFICATE OF CLASSIFICATION	
First classification survey	In connection with the first classification
PERIODICAL SURVEYS OF THE STRUCTURE	
Renewal survey of the structure (see 5)	5 years after the first classification survey or after the preceding renewal survey of the structure or According to the schedule provided by a reliability based inspection plan, if available and approved by Tasneef
Annual survey of the structure (see 8)	Every year after the beginning of the class period
NON-PERIODICAL (OCCASIONAL) SURVEYS OF THE STRUCTURE	
Occasional survey of the structure	According to the requirements of [12]

Occasional survey for the purpose of ascertaining and reporting damage to the structure	-
Note 1: Tasneef reserves the right to require that any periodical survey is held at intervals shorter than those specified in the table, anticipating the due date if this action is justified, in its opinion, by special reasons.	

2.4.2 Topside supervision For the maintenance of the Certificate of Classification, the Owner is to subject the platform to periodical surveys and inspections according to a plan that is to be agreed with Tasneef based on the operation and maintenance plans of the single process equipment and safety related systems.

In particular, a Risk-Based Inspection (RBI) plan can be adopted to fulfil the requirements for the maintenance of the certification applied to topside items.

3 Periodical surveys

3.1 Survey types

3.1.1 Classed platforms are submitted to surveys for maintenance of Class. These surveys include the annual surveys and renewal surveys, to be carried out at the intervals and under the conditions laid down in this Section. In addition to the above periodical surveys, the platforms are to be submitted to occasional surveys whenever the circumstances so require (see [12]).

3.1.2 The different types of periodical surveys are summarized in Table 2. The intervals at which the periodical surveys are carried out are given in the items referred to in second column of Table 2. The relevant extent and scope are given from [4] to [13].

3.1.3 The surveys are to be carried out in accordance with the relevant requirements in order to confirm that the structure and topside equipment comply with the applicable Rules and will remain in satisfactory conditions based on the assumption that the platform is properly operated by competent and qualified personnel according to the international and national regulations, the criteria on which the Classification is based and the manufacturer’s recommendations.

3.1.4 Any document issued by Tasneef in relation to its intervention reflects the conditions of the platform as found at the time and within the scope of the survey. It is the Interested Party’s responsibility to ensure proper maintenance of the platform until the next survey required by the Rules. It is the duty of the Interested Party to inform the surveyor when he boards the platform of any event or circumstances affecting Class.

Table 2 Types of periodical Surveys

Type of survey	Reference in this Section
Class renewal - structure	5
Class renewal - topside	6
Annual - structure	8
Annual - topside	9
Boiler - complete	9.4

3.2 Change of periodicity, postponement and advance of surveys

3.2.1 Tasneef reserves the right, after due consideration, to change the periodicity, postpone or advance surveys, taking into account particular circumstances.

3.2.2 When a survey becomes overdue, the following applies:

a) In case of a Class renewal survey, Tasneef may, under exceptional circumstances, grant an extension to allow for completion of this survey, provided that there is documented agreement to such an extension prior to the expiry date of the Certificate of Classification, adequate arrangements have been made for the attendance of the Surveyor and Tasneef is satisfied that there is technical justification for such an extension.

b) No postponement is granted for annual surveys, which are to be complete within their prescribed time windows.

3.3 Extension of the scope of surveys

3.3.1 Tasneef and/or its Surveyors may extend the scope of surveys of structure and/or topside, whenever and so far as considered necessary, or modify them in case of special systems.

3.3.2 The extent of any survey also depends on the conditions of the platform and its equipment. Should the Surveyor have any doubt as to the maintenance or condition of the platform or its equipment, or be advised of any deficiency or damage which may affect Class, then further examination and testing may be conducted as considered necessary.

3.4 General procedure of survey

3.4.1 The general procedure of survey consists in:

- an overall examination of the parts of the platform covered by the rule requirements;
- checking selected items covered by the rule requirements;
- attending tests and trials where applicable and deemed necessary by the Surveyor.

3.4.2 Tasneef survey requirements cannot be considered as a substitute for specification and acceptance of repairs and maintenance, which remain the responsibility of the Owner.

3.4.3 Tasneef will apply the regulations of Administrations concerning the scope and periodicity of surveys when they differ from those laid down in this Section.

3.4.4 During the surveys, the Surveyor does not check that the spare parts are kept on board, maintained in working order and suitably protected.

3.5 Definitions related to surveys

3.5.1 Date of build

a) For new platform:

For a new platform the date of build is the year, month and day at which the new construction survey process is completed.

Where there is a substantial delay between the completion of the construction survey process and the beginning of the platform's active service, the date of commissioning may also be specified.

b) After modifications:

After modifications are completed, the "date of build" remains assigned to the platform.

Where a complete replacement or addition of a major portion of the platform is involved, the following applies:

1) the "date of build" associated with each major portion of the platform is indicated on the Certificate of Classification where it has been agreed that the newer structure is on a different survey cycle;
2) survey requirements are based on the "date of build" associated with each major portion of the platform;
3) survey due dates may be aligned, where appropriate.

3.5.2 Date of initial classification for new platforms

In principle, for existing platforms the date of initial classification is the date of completion of the admission to class survey.

3.5.3 Date of initial classification for existing platforms

In principle, for existing platforms the date of initial classification is the date of completion of the admission to class survey.

3.5.4 Period of class

Period of class means the period starting either from the date of the initial classification, see [3.5.2], or from the credited date of the last class renewal survey, and expiring at the limit date assigned for the next class renewal survey. The assigned period of class is never to exceed five (5) years for the structure and, generally, 10 years for the topside unless differently agreed with Owner/operator. The period of class is granted only upon completion of the new building procedure and, for platforms classed after construction, upon satisfactory outcome of a survey with the scope of a renewal survey.

3.5.5 Anniversary date

Anniversary date means the day of the month of each year in the period of class which corresponds to the expiry date
of the period of class.

3.5.6 Survey time window

Survey time window, or more simply window, mean the fixed period during which annual and intermediate surveys are to be carried out.

3.5.7 Overdue surveys

Each periodical survey is assigned a limit date specified by the relevant requirements of the Rules (end of survey interval
or end date of window) by which it is to be completed.
A survey becomes overdue when it has not been completed by its limit date.
Example:
• Anniversary date: 15th April
The 2016 annual survey can be validly carried out from 16th January 2016 to 15th July 2016. If not completed by 15th July 2016, the annual survey becomes overdue.

3.5.8 Recommendations

A recommendation is a requirement to the effect that specific measures, repairs and/or surveys are to be carried out within a specific time limit in order to retain classification.
A recommendation is pending until it is cleared. Where it is not cleared by its limit date, the recommendation is overdue.

3.5.9 Memoranda
Those defects and/or deficiencies which do not affect the maintenance of class and which may therefore be cleared at the Owner's convenience and any other information deemed noteworthy for Tasneef convenience are indicated as memoranda. Memoranda are not to be regarded as recommendations.

3.5.10 Exceptional circumstances
Exceptional circumstances' means unavailability of repair facilities; unavailability of essential materials, equipment or spare parts; or delays incurred by action taken to avoid severe weather conditions.

3.5.11 Force Majeure
'Force Majeure' means any of the following:

- damage to the platform;
- unforeseen inability of Tasneef to attend the platform due to government restrictions on right of access or movement of personnel;
- unforeseeable delays in port or inability to discharge cargo due to unusually lengthy periods of severe weather, strikes or civil strife;
- acts of war;
- or other causes of force majeure.

4 Class renewal survey

4.1 General principles

4.1.1 The first class renewal survey is to be completed within:

- for the structure, 5 years from the date of the initial classification survey and thereafter 5 years from the credited date of the previous class renewal survey.
- For the topside, unless differently agreed with Owner/operator, 10 years from the date of the initial classification survey and thereafter 10 years from the credited date of the previous class renewal survey.

However, Tasneef may consider granting an extension for a maximum of three months after the limit date, in exceptional circumstances and provided that the attending Surveyor so recommends. In such cases, the next period of class will start from the limit date for the previous class renewal survey before the extension was granted.

4.1.2 For surveys completed within three months before the limit date of the class renewal survey, the next period of class will start from this limit date. For surveys completed more than three months before the limit date, the period of class will start from the survey completion date.

4.1.3 In cases where the platform has been mothballed or has been out of service for a considerable period because of a major repair or modification and the owner elects to carry out only the overdue surveys, the next period of class will start from the expiry date of the renewal survey. If the owner elects to carry out the next special survey due, the period of class will start from the survey completion date.

4.2 Continuous survey system

4.2.1 The request by the Owner for admission to the continuous survey system will be considered by Tasneef and agreement depends on the type and age of structures and topside. This system may apply to the class renewal survey of structure and/or topside. Platforms subject to the continuous survey system are to be provided with lists of items to be surveyed under this system.

4.2.2 For items inspected under the continuous survey system, the following requirements generally apply:

a) the interval between two consecutive surveys of each item is not to exceed five years for structures and 10 years for static components of the topside;
b) the interval between two consecutive surveys of each active machinery item follow manufacturers' recommendations for overhauls when the item is in continuous use, and is not to exceed five years for standby equipment that does not accumulate running hours;
c) the items are to be surveyed in rotation, so far as practicable ensuring that approximately equivalent portions are examined at regular times;
d) Tasneef may credit for continuous survey results of inspections carried out before the admission to the continuous survey scheme;
e) each item is to be surveyed at one time, as far as practicable; Tasneef may, however, allow possible repair work to be carried out within a certain period;

The Surveyor may, at his discretion, extend the inspection to other items, if previous inspections carried out revealed any defects.
Upon application by the Owner, Tasneef may agree, subject to certain conditions, that some items of machinery which are included in the continuous survey cycle are examined by designated personnel where Tasneef is not represented. The Owner/operator is responsible for ensuring that the maintenance on Class-related topside items is carried out by personnel in possession of the appropriate skills and qualifications.

The continuous survey system may be discontinued at any time at the discretion of Tasneef, or at the request of the Owner, and a specific arrangement devised.

4.2.3 A planned maintenance scheme may be considered as an alternative to the continuous survey system for machinery and is limited to components and systems covered by it. When such a system approved by Tasneef is implemented, a survey scheme other than those normally adopted and with intervals different from those of the continuous survey system as detailed in [6.2] may be accepted.

4.2.4 The conditions for approval of the planned maintenance scheme, the determination of survey item intervals and the general scope of surveys are detailed in [10].

4.2.5 The planned maintenance scheme does not supersede the annual surveys and other periodical surveys.

4.2.6 A general examination of the machinery, as detailed in [9] for annual surveys, is to be carried out at the end of the period of class.

4.2.7 The planned maintenance scheme may be discontinued at any time at the discretion of Tasneef, or at the request of the Owner.

5 Renewal survey of the structure

5.1 General principles

5.1.1 A new period of class is assigned to the platform after the satisfactory completion of the class renewal survey, and a new Certificate of Classification with relevant annexes is issued for the new period of class.

5.1.2 In addition to all the inspections in the annual survey, the renewal survey of the structure is to include the following:

a) all decks and structures, all spaces and all structural compartments intended for fresh water, fuel or lube oil are to be inspected after cleaning and ventilation.
b) the structural elements are to be exposed and cleaned as required by the Surveyor for proper examination. Careful examination is to be performed of those parts of the structure which are more liable to excessive corrosion, deterioration or damage during sea service.
c) the Surveyor may require thickness measurements to be carried out by suitable means where signs of deterioration are evident or where deterioration is normally found.
d) any parts of the structure which are found to be defective or to have scantlings reduced, even locally, beyond the acceptable limits are to be renewed or, if appropriate, adequately compensated.
e) surfaces are to be re-coated as necessary;
f) connection members and structural joints, both for above water and underwater portions of the structure, are to be carefully examined in general;
g) non-destructive examinations are required for typical welded joints and particularly for those joints which are subject to stress concentrations and fatigue, taking account of the inspections carried out at the annual surveys and of the survey program agreed upon with Tasneef on a case by case basis;
h) tanks and compartments intended for liquid cargoes are to be hydrostatically tested by a head corresponding to the maximum head which can be experienced in service.

At the request of the Owner, Tasneef may allow the operations listed above connected with the renewal survey to be carried out according to a continuous survey cycle, in compliance with criteria and general conditions stated below, as far as applicable.

For items inspected under the continuous survey system, the following requirements generally apply:

a) the interval between two consecutive surveys of each item is not to exceed five years
b) the items are to be surveyed in rotation, so far as practicable ensuring that approximately equivalent portions are examined each year
c) Tasneef may credit for continuous survey results of inspections carried out before the admission to the continuous survey scheme
d) each item is to be surveyed at one time, as far as practicable; Tasneef may, however, allow possible repair work to be carried out within a certain period.
e) the Surveyor may, at his discretion, extend the inspection to other items, if previous inspections carried out revealed any defects.

Upon application by the Owner, Tasneef may agree, subject to certain conditions, that some items of machinery which are included in the continuous survey cycle are examined by responsible persons, designated under the responsibility of the Owner/operator, where Tasneef is not represented.

5.1.3 Platforms on the continuous survey system are not exempt from other periodical surveys.

5.1.4 The above does not exempt the Owner/operator from the obligation of carrying out the annual surveys of the structure in compliance with the stated deadlines.

6 Renewal survey of the topside

6.1 General principles

6.1.1 The period of class coincides with the production stop for major equipment overhaul, and is assumed to be 10 years unless differently agreed with the Owner/operator.

Assuming a 10-year Class period, the first class renewal survey is to be completed within 10 years from the date of the initial classification survey and thereafter 10 years from the credited date of the previous class renewal survey. However, Tasneef may consider granting an extension for a maximum of three months after the limit date, in exceptional circumstances and provided that the attending Surveyor so recommends. In such cases the next period of class will start from the limit date for the previous class renewal survey before the extension was granted.

6.1.2 For surveys completed within three months before the limit date of the class renewal survey, the next period of class will start from this limit date. For surveys completed more than three months before the limit date, the period of class will start from the survey completion date.

6.1.3 In cases where the platform has been mothballed or has been out of service for a considerable period because of a major repair or modification and the owner elects to carry out only the overdue surveys, the next period of class will start from the expiry date of the renewal survey. If the owner elects to carry out the next special survey due, the period of class will start from the survey completion date.

6.1.4 A new period of class is assigned to the platform after the satisfactory completion of the class renewal survey, and a new Certificate of Classification with relevant annexes is issued for the new period of class.

6.2 Continuous Machinery Survey

6.2.1 Documentation

The basic conditions for the acknowledgment of surveys carried out by the designated persons are specified hereafter. Consideration may be given to other conditions on a case by case basis.
The designated persons must be permanent employees of the Company, which is responsible for ensuring their proper skills and qualifications to carry out maintenance of Class-related items.

6.2.2 Limits of the interventions

For platforms where the CMS is implemented, the following items of the class renewal survey for machinery cannot be inspected by the onboard personnel:

- pressure vessels (except for class 2 and 3 heat exchangers)
- main and auxiliary turbines
- main reduction gears.

Generally, within a 10-year cycle comprising two consecutive class cycles, all the items surveyed under CMS are to be inspected once by Tasneef Surveyors.

6.2.3 For platforms where the PMS is implemented the items listed in [6.2.2] cannot be surveyed by the responsible designated personnel.
Where a Planned Maintenance Scheme approved by Tasneef is implemented and a Condition Based Maintenance approved by Tasneef is applied, main and auxiliary turbines can be surveyed by the responsible designated persons, on condition that they are subjected to the Condition Based Maintenance (CBM) program.
In no case may the surveys of the following items be carried out by the designated persons:

- pressure vessels (except class 2 and 3 heat exchangers)
- boilers.

7 Procedure for carrying out surveys

7.1 General principles

7.1.1 General

As to the procedure for carrying out surveys, the Owner/operator is to inform the designated persons that surveys are to be conducted in accordance with the Rules of Tasneef and, specifically, the requirements for class renewal surveys related to structure and topside systems contained in [5] and [6].

It is the responsibility of the Owner/operator of the platform to decide the date for the survey of each component in order to avoid possible accidents (fire included) in the event of damage to the unit(s) remaining in service.

Some guidelines for the designated persons relevant to the dismantling and inspections of main components of the machinery installations are given below.

The items and/or machinery which, as a result of the surveys, are replaced due to wear, damage or defects, are to be kept on the platform until they are inspected by a Surveyor of Tasneef.

When deficiencies relating to possible safety management system failures are identified by the Surveyor during a periodical (annual//renewal) class survey or occasional class survey, additional surveys carried out by the Administration or any other occasion, a report is to be completed by the Surveyor so that the Organisation responsible for the safety management is notified.

Reporting and follow-up actions will be performed in accordance with Tasneef procedures.

7.1.2 Auxiliary diesel engines

The survey generally consists in the complete dismantling of the engine and a careful examination of those items most liable to be exposed to wear or operating incidents.

In particular:

- crankshaft deflections and wear of cylinder liners are to be measured
- the crankshaft is to be checked by means of dye penetrant in way of fillets and lubricating oil holes
- all top halves of the main bearings together with at least two bottom halves are to be dismantled
- crankcase explosion relief valves, if fitted, are to be checked.

7.1.3 Reciprocating compressors

The survey is to include:

- the dismantling of pistons and valves for inspection
- the examination and testing of the nest of cooler tubes
- the verification of safety relief valves after reassembling.

7.1.4 Coolers, condensers, heaters

The survey is to include:

- the dismantling of the covers
- the examination of the nest of tubes
- the testing of the nest of tubes, if necessary.

7.1.5 Electrical switchboard

The survey is to include:

- the cleaning of the switchboard
- the verification of the connection assemblies, locking device tightening and busbar tightening
- the examination of the condition of the circuit-breakers, switches and fuses
- the verification of the contacts and screens
- the checking of the measuring instruments, which are to be re-calibrated or replaced, if inaccurate
- the megger test.

7.1.6 Alternating current and direct current generators

The survey is to include:

- the removal of protection plates and brush carriers
- the cleaning of field coils and armature windings
- the verification of proper contact of brushes, which are to be renewed if excessively worn
- the verification of commutators and sliprings
- the measurement of air gap clearances
- the checking of journals and bearings
- the megger test.

7.1.7 Other items (pumps, electric motors, etc.)

The survey is to generally to include the complete dismantling for inspection of the main parts exposed to wear or operating incidents, such as bearings, casings, impellers and rotors.

8 Annual survey of the structure

8.1 General principles

8.1.1 In the five-year period of Class for structures, five annual surveys are to be carried out. The first to fourth annual surveys have a six-month window, i.e. from three months before to three months after each anniversary date, while the fifth annual survey has only a three-month window, i.e. from three months before up to the fifth anniversary date.

8.1.2 The platform is to be inspected every year for the purpose of ensuring that the structure and its equipment are maintained in a good and efficient condition and that no unapproved modifications or alterations have been made which could affect the safety of the platform.

To this end, the following checks are to be carried out:

a) weather decks, relevant equipment and apparatus are to be examined;

b) all structures above water are to be generally examined, in particular in way of more critical zones for structural importance and stress level;

c) the splash zone of the platform is to be carefully examined to detect possible deterioration due to corrosion or collision with ships or barges;

d) the protection system against corrosion is to be examined and tested as needed to check its condition and operation;

e) inspection as needed to determine the amount of marine fouling and the presence of debris on the structures.

Other inspection methods (ultrasonic, X-ray examinations, etc.) may be used where required in addition to the visual examination.

The Surveyor may also require further inspections according to relevant survey programs previously approved by Tasneef on a case by case basis. In the course of the 2nd and 3rd annual survey of each period of class, or according to the approved survey program, in addition to the requirements already set forth, the following are to be complied with:

a) foundations are to be examined as needed to check their condition;

b) a portion of underwater structures is to be carefully examined by non-destructive examinations of typical welded joints and particularly of critical joints subject to stress concentration and to fatigue. To this end a specific inspection program is to be prepared to locate areas which are more liable to damage or fatigue.

For this purpose Tasneef reserves the right to accept the use of adequate inspection methods, as specified in [1.1.3], as an alternative to visual examination.

Preference will be given to those underwater inspection techniques which, in addition to providing information record to be examined upon completion of survey, also ensure good two-way communication allowing the Surveyor to give proper directions to the diver from deck.

The survey is to be carried out with good conditions of visibility and with lighting adequate to the water depth.

Where defects are found due to damage, extensive corrosion or wear, additional suitable checks may be required, to be extended to parts of the structure similar to those damaged.

9 Annual survey of the topside

9.1 General principles

9.1.1 The topside is to be inspected every year for the purpose of ensuring that the structure and its equipment are maintained in a good and efficient condition and that no unapproved modifications or alterations have been made such as to affect the safety of the platform. The annual surveys have a six-month window, i.e. from three months before up to three months after each anniversary date, except the last one of the class period that has only a three-month window, i.e. from three months before up to the next anniversary date.

9.1.2 The Owner/operator or its representative is to declare to the attending Surveyor that no modifications or alterations which might impair safety have been made to the various installations in hazardous areas without prior approval from Tasneef.

9.2 Static components

9.2.1 Examination of the inspection and maintenance report of static components (e.g. piping, heat exchangers and the like) is to be carried out. Such report is to be based on the Risk-Based Inspection (RBI) approach according to API 581 or equivalent standard deemed acceptable by Tasneef.

9.3 Machinery installations

9.3.1 Examination of the test, inspection and maintenance plans with the relevant logbook. Such plans are to comply at least with:

- the legislation in force and Class rules
- manufacturers' recommendations and operating manuals
- critical item list inferred from the Safety Case
- Condition-based maintenance strategy, if implemented
- Reliability-Centered Maintenance strategy, if implemented.

9.3.2 The survey of general machinery installations is to cover at least the following items, as applicable:

- general examination of machinery and boiler spaces with particular attention to the fire and explosion hazards
- general examination of the machinery, steam, hydraulic, pneumatic and other systems and their associated fittings, for confirmation of their proper maintenance
- testing of the means of communication and order transmission among control stations
- examination, as far as practicable, of the bilge pumping systems and bilge wells, including operation of the pumps, remote reach rods and level alarms, where fitted
- visual examination of the condition of any expansion joints in sea water systems
- external examination of pressure vessels other than boilers and their appurtenances, including safety devices, foundations, controls, relieving gear, high pressure piping, insulation and gauges
- visual examination of mechanical components used for cooling and maintaining a required ambient temperature in environmentally controlled spaces
- examination of cargo and process piping, including the expansion arrangements, insulation from the hull structure, pressure relief and drainage arrangements

- examination of vapour and gas tightness devices of the openings in way of ends of superstructures and deckhouses facing the process area or loading/unloading arrangements, and closing devices of air intakes and openings into accommodation, service and machinery spaces and control stations examination of venting systems, including vent masts and protective screens, for cargo tanks, interbarrier spaces, hold spaces, fuel tanks and ballast tanks
- examination of cargo tank and interbarrier space relief valves and associated safety systems and alarms
- confirmation that the certificate for the relief valve opening/closing pressures is on board
- examination of drip trays or insulation for deck protection against leakage of pollutant or flammable liquids
- examination of the pump rooms, compressor rooms and control rooms
- confirmation of proper maintenance of arrangements for the airlocks
- confirmation that any liquid and vapour hoses are suitable for their intended purpose and, where appropriate, type approved or marked with the date of testing and in satisfactory condition
- confirmation that any special arrangement made for loading/unloading is satisfactory
- confirmation that relevant instruction and information material such as process plans, filling limit information, cooling down procedures, etc. is available on the platform
- confirmation that any special arrangements to survive conditions of damage are in order.
- examination of mechanical ventilation fans in gas-dangerous spaces and zones
- examination and confirmation of the satisfactory operation of mechanical ventilation of spaces normally entered during operation
- examination, as far as possible during operation, of heat exchangers, vaporisers, pumps, compressors and hoses
- confirmation that fixed and/or portable ventilation arrangements provided for spaces not normally entered are satisfactory
- examination of the gas detection safety arrangements for control rooms and of the measures taken to exclude ignition sources when such spaces are not gas safe
- examination of cargo (if accessible), bilge, ballast and stripping pumps for excessive gland seal leakage
- confirmation that electrical equipment in gas-dangerous spaces and zones is in satisfactory condition and has been properly maintained
- confirmation that, if fitted, cargo reliquefaction or refrigeration equipment is in satisfactory condition
- confirmation that the manually operated emergency shutdown system together with the automatic shutdown of the process systems are satisfactory
- confirmation that the arrangements for the air locks are being properly maintained
- check installation of lifting appliances on modules, their safety devices and witness load tests
- carry out resolution of black-out
- testing programmable electronic controller, in particular upon loss and restoration of power supply.

9.4 Boilers

9.4.1 For main and auxiliary boilers, the annual survey consists of an external examination of boilers and their appurtenances, including safety devices, foundations, controls, relieving, high pressure and steam escape piping, insulation and gauges.

9.4.2 For thermal oil heaters, a functional test while in operation is to be carried out, during which the following items are checked:

- the heater for detection of leakages
- the condition of the insulation
- the operation of indication, control and safety devices
- the condition of remote controls for shut-off and discharge valves

A satisfactory analysis of the quality of oil is to be made available to the Surveyor.

9.4.3 For exhaust gas thermal oil heaters, in addition to the above requirements, a visual examination and a tightness testing to the working pressure of the heater tubes are to be carried out.

9.5 Electrical machinery and equipment

9.5.1 The survey of electrical machinery and equipment is to cover the following items:

- general examination, visually and in operation, as feasible, of the electrical installations for power and lighting, in particular main and emergency generators, electric motors, batteries, switchboards, switchgears, cables and circuit protective devices, indicators of electrical insulation and automatic starting, where provided, of emergency sources of power
- checking, as far as practicable, the operation of emergency sources of power and, where they are automatic, also including the automatic mode of changeover from normal power to emergency power
- check batteries for tightening of connections, charging arrangements, protective devices of the terminals against accidental contacts and charge conditions.

9.5.2 The survey is also to cover electrical components used for cooling and maintaining a required ambient temperature in environmentally controlled spaces.

9.6 Instrumentation and safety devices

9.6.1 The survey is to include:

a) confirmation that installed pressure gauges on process lines and loading/ discharge lines are operational (see Note 1)

b) confirmation that vessel liquid level gauges are operational and that high level alarms as well as automatic shut-off systems are satisfactory (see Note 1)

c) confirmation that the temperature indicating equipment of the cargo containment system and associated alarms are satisfactory (see Note 1)

d) examination of the log-books for confirmation that the emergency shutdown system has been tested

e) confirmation that cargo tank, hold and insulation space pressure gauging systems and associated alarms are satisfactory

f) examination, and testing as appropriate, of fixed gas detection equipment

g) confirmation of the availability and suitability of the portable gas detection equipment and instruments for measuring oxygen levels.

h) for ESD systems:

- check of suitability with regard to area classification
- check conditions of safety sensors/wiring
- check conditions of pneumatic and hydraulic systems
- electrical and pressure test as applicable to ESD system
- operational tests.

Note 1: Verification of these devices is to be carried out by one or more of the following methods:
• visual external examination
• comparing of read-outs from different indicators
• consideration of read-outs with regard to the actual cargo and/or actual conditions
• examination of maintenance records with reference to the process plant instrumentation maintenance manual
• verification of calibration status of the measuring instruments.

9.7 Inert gas/air drying systems

9.7.1 The survey is to include:

a) the examinations and tests as provided for the annual survey of inert gas systems

b) confirmation that arrangements are made for sufficient inert gas to be carried to compensate for normal losses and that means are provided for monitoring the spaces

c) confirmation that the use of inert gas has not increased beyond that needed to compensate for normal losses by examining records of inert gas usage

d) confirmation that the means for prevention of backflow of flammable vapour to gas-safe spaces are in satisfactory

a) operating condition

e) confirmation that any air drying system and any interbarrier and hold space purging inert gas system are satisfactory.

9.8 Fire protection, detection and extinction

9.8.1 The survey of fire prevention includes:

- the examination, as far as practicable, and testing, as feasible and at random, of fire and/or smoke detection systems and active protection systems
- the examination of arrangements for gaseous fuel for domestic purposes
- the examination of Fire control plan and Structural fire protection plan to check the correspondence with the actual layout
- the detailed examination of Structural fire protection in the in significant selected locations for ascertaining both the maintenance of the good condition of the structural fire protection and that no modifications in the structural fire protection have been carried out since the previous survey.
- review of certificates of passive fire protection materials (bulkheads/decks, doors, windows, surface linings, Intumescent paints etc.)
- check operation of fire dampers and shutoff dampers
- check operation of accommodation fire doors
- check differential pressure between safe and hazardous areas and between hazardous areas of different classes.

9.9 Means of escape and emergency lighting

9.9.1 The survey of means of escape includes:

- Check escape routes for proper marking and absence of obstructions
- Check status of lifesaving equipment
- Lighting of exits and helicopter landing area
- Check changeover of lighting system from normal to emergency power.

9.10 Records of surveys carried out

9.10.1 The surveys carried out by the designated persons are to be recorded in a log-book and a survey report is to be prepared for each item surveyed.

The report is to be provided in by means of a computerised recording system.

9.10.2 The report is to indicate the following information:

- identification data:
- name of platform and register number
- name of designated persons and reference of Tasneef authorisation
- date of the survey
- reference of the item in the CMS or PMS list, and description of the item
- inspection conducted:
- the type of inspection carried out: visual external examination, internal examination after dismantling, overhaul
- readings performed, when applicable: clearances ,measurements, working pressure, or other working parameters of the equipment
- inspection findings: corrosion, fractures, pieces of equipment worn out, broken or missing
- maintenance and repairs carried out and parts replaced
- results of tests performed after the inspection, such as working test, pressure test.

For sake of completeness, other documentation such as sketches, photos, measurement reports may be attached to the report.

The report is to be signed by the designated persons.

9.11 Confirmatory survey

9.11.1 A confirmatory survey, to be carried out by a Surveyor of Tasneef, is to be requested according to the following principle:

- for ships under the CMS, within a reasonably short time from the date of the surveys carried out by the designated persons;
- • for ships under the PMS, at the next annual survey.

9.11.2 The Surveyor is to be supplied with a copy of this survey report and also shown the engine log-book.

9.11.3 The Surveyor carries out an external examination of the relevant items and parts replaced and, if applicable, attends running tests. If doubts arise, the Surveyor may request dismantling as deemed necessary.

9.11.4 Where the confirmatory survey is performed with an abnormal delay, the inspection is to be more extensive and, if necessary, the due surveys are to be completely repeated.

9.11.5 The date of the execution of the surveys will be assumed to be the date of the confirmatory survey.

10 Planned maintenance scheme (PMS) for machinery

10.1 General principles

10.1.1 This scheme is limited to components and systems covered by CMS. Any items not covered by the PMS are to be surveyed and credited in the usual way.

10.1.2 This survey scheme is to be approved by Tasneef before being implemented.

10.1.3 When the PMS is applied, the scope and periodicity of the class renewal survey are tailored for each individual item of machinery and determined on the basis of recommended overhauls stipulated by the manufacturers, documented experience of the operators, a RCM study and, where applicable and fitted, condition based maintenance (CBM). When the CBM of machinery and components included in the approved PMS shows that their condition and performance are within the allowable limits, no overhaul is necessary, unless specified by the Manufacturer.

10.1.4 The surveys of machinery items and components covered by the PMS may be carried out by personnel on board who have been appropriately trained and qualified under the responsibility of Owner/operator.

Items surveyed by the authorised personnel will be subject to the implementation survey and annual surveys as detailed in [10.3.1] and [10.3.2].

10.1.5 On board the platform there is to be a person responsible for the management of the PMS; he can delegate the implementation of the scheme to persons who are to possess the appropriate professional qualifications.

10.1.6 Documentation on overhauls of items covered by the PMS is to be recorded and signed by the person responsible for the management of the PMS.

10.1.7 Access to computerised systems for updating of the maintenance documentation and maintenance program is only to be permitted to the authorized persons.

10.2 Conditions and procedures for the approval of the system

10.2.1 General

The PMS is to be approved by Tasneef. To this end the Owner is to make a formal request to Tasneef and provide the information specified in [10.2.3].

10.2.2 System requirements

The PMS is to be programmed and maintained by a computerised system. Computerised systems are to include back-up devices, which are to be updated at regular intervals.

10.2.3 Information

The information to be submitted to Tasneef is to include:

a) a description of the scheme and its application on board, including documentation completion procedures, as well as the proposed organisation chart identifying the areas of responsibility and the people responsible for the PMS on board

b) the list of items of machinery and components to be considered for classification in the PMS, distinguishing for each the principle of survey periodicity

c) the procedure for the identification of the items listed in b), which is to be compatible with the identification system adopted by Tasneef

d) the scope and time schedule of the maintenance procedures for each item listed in b), including acceptable limit conditions of the parameters to be monitored based on the manufacturers' recommendations or recognised standards and laid down in appropriate preventive maintenance sheets

e) the original baseline data, obtained on board, for machinery undergoing maintenance based on CBM

f) the list and specifications of the CBM equipment, including the maintenance and CBM methods to be used, the time intervals for maintenance and monitoring of each item and acceptable limit conditions

g) the baseline data of the machinery checked through CBM

h) the document flow and pertinent filing procedure.

10.2.4 The submission of the information specified in [10.2.3] may be in hard copy or electronic version; alternatively, the same information may be acquired by Tasneef through remote access to the onboard ccomputerized system, if the Owner/operator so desires.

10.2.5 The following information is to be available on board:

a) the information listed in [10.2.3], duly updated

b) the maintenance instructions for each item of machinery, as applicable (supplied by the manufacturer or by the shipyard)

c) the CBM data of the machinery, including all data since the last dismantling and the original reference data

d) reference documentation (trend investigation procedures etc.)

e) the records of maintenance performed, including conditions found, repairs carried out, spare parts fitted

f) the list of personnel on board in charge of the PMS management.

The validity of the PMS is to be first confirmed, then maintained through annual surveys..

10.2.6 The survey arrangement for machinery under the PMS can be cancelled by Tasneef if it is apparent that the PMS is not being satisfactorily carried out either from the maintenance records or the general condition of the machinery, or when the agreed intervals between overhauls are exceeded.

10.2.7 The case of sale or change of management of the platform or transfer of class is to cause the approval to be reconsidered.

10.2.8 The Owner/operators may, at any time, cancel the survey arrangement for machinery under the PMS by informing Tasneef in writing and in this case the items which have been inspected under the PMS since the last annual survey can be credited for class at the discretion of the attending Surveyor.

10.3 Surveys

10.3.1 Implementation Survey

The Implementation Survey is to be carried out by Tasneef's Surveyor within one year from the date of approval.
The scope of this survey is to verify that:

- the PMS is implemented in accordance with the approved documentation and is suitable for the type and complexity of the components and systems onboard
- the information required for the annual survey is produced by the PMS
- the requirements of surveys and testing for retention of class are complied with
- the onboard personnel are familiar with the PMS procedures and the CBM, if applied
- the CBM data, including baseline data and all data since the last dismantling of the machinery checked through CBM, are stored and managed correctly.

10.3.2 Annual Survey of the PMS

An annual survey of the PMS is to be carried out by a Surveyor of Tasneef and preferably concurrently with the annual survey of machinery. The Surveyor is to check that any change to the approved PMS is submitted to Tasneef for agreement and approval.

The purpose of this survey is to verify that the scheme is being correctly operated, in particular that all items (to be surveyed in the relevant period) have actually been surveyed in due time, and that the machinery has been functioning satisfactorily since the previous survey. A general examination of the items concerned is to be carried out.

The performance and maintenance records are to be examined to verify that the machinery has functioned satisfactorily since the previous survey or action has been taken in response to machinery operating parameters exceeding acceptable tolerances and that the overhaul intervals have been maintained.

Written details of breakdown or malfunction are to be made available.

Description of repairs carried out is to be examined. Any machinery part which has been replaced by a spare due to damage is to be retained on board, where possible, until examined by a Surveyor of Tasneef.

At the discretion of the Surveyor, function tests, confirmatory surveys and random check readings, where condition monitoring equipment is in use, are to be carried out as far as practicable and reasonable.

Upon the satisfactory outcome of this survey, the Surveyor confirms the validity of the PMS and decides which items can be credited for class.

10.4 Damage and repairs

10.4.1 Damage to components or items of machinery is to be reported to Tasneef. The repairs of such damaged components or items of machinery are to be carried out to the satisfaction of the Surveyor.

Any repair and corrective action regarding machinery under PMS is to be recorded in the PMS logbook and repair verified by the Surveyor at the annual survey.

In the case of overdue outstanding recommendations or records of unrepaired damage which would affect the PMS, the relevant items are to be kept out of the PMS until the recommendations are fulfilled or the repairs carried out.

11. Machinery survey in accordance with a Condition Based Maintenance program

11.1 General on Condition Based Maintenance

11.1.1 Condition Based Maintenance (CBM) is the process of extracting prognostic information from machines to indicate their actual wear and degradation and the relevant rate of change (i.e. trend), on the basis of which the maintenance tasks can be adjusted flexibly in accordance to their actual status.

11.1.2 The cost effectiveness of the CBM approach is related to the criticality of the monitored items, the reliability of the CBM techniques in providing valuable information and the ease of the interpretation of the results and their trends. In any case, especially for complex machine types, it cannot be expected that CBM can predict the failure mechanism of every component, and opening up will remain the only possible solution to check certain items.

11.1.3 The choice of the items to be included in the CBM program is up to the Owner/operator.

11.1.4 The minimum parameters to be checked in order to monitor the conditions of the various machinery for which this type of maintenance is accepted are indicated in Appendix 1.

11.1.5 The frequency of the measurements can be increased according to the criticality of the equipment. In general, the CBM strategy and its extent, inclusive of the acceptability limits, are to be approved by the Manufacturer. CBM techniques not included in this Section may be accepted if they are proposed or established by the Manufacturer of a machine.

11.1.6 Guidance on CBM can be found in the Tasneef "Guide for the Application of Condition Based Maintenance in the Planned Maintenance Scheme".

11.2 Roles and Responsibilities

11.2.1 Owner/Operator

At the time of the request for approval of the machinery Planned Maintenance Scheme, the Owner/Operator is to submit the CBM details as specified in Appendix 1], the techniques and the tools that will be employed; for onboard instrumentation, the operating manual and user's guide supplied by the Manufacturer are to be part of the platform's maintenance documentation.

The strategy for the items subjected to CBM is to be computer based and a minimum number of readings is to be taken during the period between annual surveys. CBM does not absolve the machinery personnel of the responsibility to perform visual inspections of the items.

The reading points are to be clearly marked and identified by Memory Identification Card.

The documentation is also to include the responsibility chart of the dedicated human resources for CBM, which may be internal (i.e. onboard or shoreside staff) or external (professional engineering companies), and the relevant qualifications.

The CBM strategy, inclusive of the description of the tools to be used, dedicated personnel, measurements to be taken etc, is to be an integral part of the PMS survey and is to be included in a dedicated section of the PMS manual.

11.2.2 Society

The Planned Maintenance Scheme will be reviewed for approval with particular reference to the CBM proposals.

Tasneef reserves the right to require the baseline measurements for a period of at least six months, according to the age and condition of the platform.

Tasneef's Surveyors retain the right to test or open up the machinery, irrespective of the presence of CBM, if deemed necessary.

11.2.3 Responsible onboard personnel

The presence of a CBM does not absolve the responsible onboard personnel from his duties, including the responsibility for interventions on machines according to his experience and judgment.

The onboard personnel is to ensure that the CBM parameters are recorded at the agreed intervals. This is to include an initial or "baseline" set of readings, against which further data can be compared.

11.2.4 Annual survey

The requirements for an annual survey of the machinery maintenance and monitoring records are the same as those given in [10.3.2]. At the annual survey the responsible onboard personnel is to make available the following maintenance and monitoring records, in addition to those specified in [10.3.2]:

- CBM records for each item to be credited for class. The records are to indicate where acceptable limits have been exceeded and what actions were taken.

- Calibration certificates for instrumentation used to take measurements, if applicable.

The responsibilities of Tasneef's Surveyors at the annual survey, additional to those described in [10.3.2], are:

a) to examine the machinery and monitoring records in sufficient depth to ensure that the scheme has been operated correctly and that the machinery has functioned satisfactorily since the previous survey.

b) to examine the CBM records to verify that the. parameters lie within the specified limits (or, in the case of a malfunction in a machine, to check the readings taken just before the malfunction for information to be used in the preparation of the relevant Damage Report). Baseline condition data are to be compared with subsequent readings to ascertain the trend characteristics. Tasneef's Surveyors may require confirmatory readings on available running machinery to be taken for comparison with the records.

c) to check the calibration certificates for CBM instrumentation and probe the crew's ability to manage CBM tools and records.

12. Occasional surveys

12.1 General

12.1.1 An occasional survey is any survey which is not a periodical survey. The survey may be defined as an occasional survey of structure, machinery, boilers, refrigerating plants, etc., depending on the part of the platform concerned.

12.1.2 Where defects are found, the Surveyor may extend the scope of the survey as deemed necessary.

12.1.3 Occasional surveys are carried out at the time of, for example:

- updating of classification documents (e.g. change of the Owner, name of the platform)
- damage or suspected damage
- repair or renewal work
- administration inspections
- alterations or conversion
- quality system audits
- postponement of surveys or recommendations.

12.2 Damage and repair surveys

12.2.1 In the event of damage which affects or may affect the class of the platform, the Owner/operator is to apply to Tasneef for a survey. Such application is to be made as soon as possible to enable the Surveyor to ascertain the extent of the damage and necessary repairs, if any.

Note 1: Whenever a platform is fitted with a helicopter platform which is made in aluminium or other low melting metal construction which is not made equivalent to steel, and a fire occurred on the said platform or in close proximity, the platform is to be subject to a structural survey to determine its suitability for further use.

12.2.2 All repairs to structure, machinery and equipment which may be required in order for a platform to retain its class are to be to the satisfaction of the Surveyor. During repairs or maintenance work, the Owner is to arrange so that any damage, defects or non-compliance with the rule requirements are reported to the Surveyor during his survey.

12.2.3 Damages and partial or temporary repairs considered acceptable by the Surveyor for a limited period of time are the subject of an appropriate recommendation.

12.2.4 Damages or repairs required by the Surveyor to be re-examined after a certain period of time are the subject of an appropriate recommendation.

13 Administration survey

13.1 General

13.1.1 An occasional survey is to be requested by the Owner wherever the production of a platform is stopped following an inspection by an Authority having jurisdiction over the platform.

14 Conversions, alterations and repairs

14.1 General

14.1.1 Conversions, alterations or repairs of/to structures and arrangements affecting class are to be carried out in accordance with the requirements of Tasneef and to its satisfaction. Where necessary, documentation is to be submitted to Tasneef and/or made available to the attending Surveyor.

14.1.2 Materials and equipment used for conversions, alterations or repairs are generally to meet the requirements of the Rules for new platforms built under survey.

15 Change of ownership

15.1 General

15.1.1 In case of change of ownership, the platform retains its current class with Tasneef provided that:

- Tasneef is informed of the change sufficiently in advance to carry out any survey deemed appropriate, and
- the new Owner signs the appropriate request, involving acceptance of the

acceptance of Tasneef general conditions and Rules.

16 Mothballing

16.1 General principles

16.1.1 A platform put out of commission, which may be subject to subsequent start-up or scrap, is to comply with specific requirements for maintenance of class, as specified below, provided that the Owner/operator notifies Tasneef of the fact.

If the Owner/operator does not notify Tasneef of the mothballing of the platform or does not implement the mothballing maintenance program, the class will be suspended and/or withdrawn when the due surveys are not carried out by their limit dates in accordance with the applicable requirements given in Pt A Ch 2, [2.5.6].

16.1.2 The mothballing maintenance program provides for a “mothballing survey” to be performed at the beginning of mothballing and subsequent “annual mothballing condition surveys” to be performed in lieu of the normal annual surveys which are no longer required to be carried out as long as the platform remains mothballed. The minimum content of the mothballed maintenance program as well as the scope of these surveys are given in Appendix 2. The other periodical surveys which become overdue during the mothballing period may be postponed until the re-commissioning of the platform.

16.1.3 Where the platform has an approved mothballing maintenance program and its period of class expires, the period of class is extended until it is re-commissioned, subject to the satisfactory completion of the annual mothballing condition surveys as described in [16.1.2].

16.1.4 The periodical surveys carried out during the mothballing period may be credited, either wholly or in part, at the discretion of Tasneef, having particular regard to their extent and dates. These surveys will be taken into account for the determination of the extent of surveys required for the re-commissioning of the platform and/or the expiry dates of the next periodical surveys of the same type.

16.1.5 When a platform is re-commissioned, the Owner/operator is to notify Tasneef and make provisions for the platform to be submitted to the following survey:

- an occasional survey prior to re-commissioning, the scope of which depends on the duration of the mothballing period
- all periodical surveys which have been postponed in accordance with [16.1.2], taking into account the provisions of [16.1.4]. In all cases where the Owner/operator elects to carry out the “next due” renewal survey, the due periodical structure and topside surveys will be replaced by this one, Class period will be assigned in accordance with the provisions of [16.1.4].

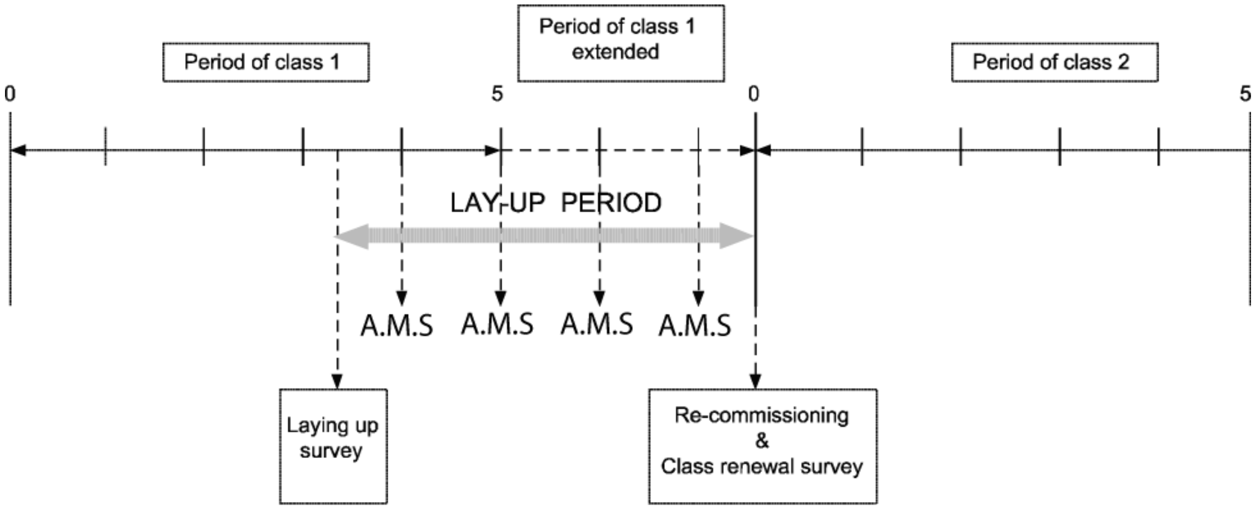
16.1.6 Where the previous period of class expired before the re-commissioning and was extended as stated in [16.1.3], in addition to the provisions of [16.1.5] a complete class renewal survey is to be carried out prior to re-commissioning.

Those items which have been surveyed in compliance with the class renewal survey requirements during the 15 months preceding the re-commissioning may be credited. A new period of class is assigned from the completion of this class renewal survey.

16.1.7 The principles of intervals or limit dates for surveys to be carried out during the lay-up period, as stated in [16.1.1] to [16.1.6], are summarised in Figure 1.

The scope of the laying-up survey and annual lay-up condition surveys are described in detail in Appendix 2.

Figure 1: Survey scheme of a case of a lay-up going beyond the expiry date of the period of class



Note 1: M. S. means annual mothballing condition survey.

APPENDIX 1 MACHINERY SURVEY IN ACCORDANCE WITH A CONDITION BASED MAINTENANCE PROGRAM

1 General on Condition Based Maintenance

1.1

Condition Based Maintenance (CBM) is the process of extracting prognostic information from machines to indicate their actual wear and degradation and the relevant rate of change (i.e. trend), on the basis of which the maintenance tasks can be adjusted flexibly in accordance to their actual status. The cost effectiveness of the CBM approach is related to the criticality of the monitored items, the reliability of the CBM techniques in providing valuable information and the ease of the interpretation of the results and their trends. In any case, especially for complex machine types, it cannot be expected that CBM can predict the failure mechanism of every component, and opening up will remain the only possible solution to check certain items.

The choice of the topside items to be included in the CBM program is up to the Owner./operator

The minimum parameters to be checked in order to monitor the conditions of the various machinery for which this type of maintenance is accepted are indicated in [3] and [4]. Machinery items not included in this Appendix can be taken into consideration on a case by case basis. The frequency of the measurements can be increased according to the criticality of the equipment. In general, the CBM strategy and its extent, inclusive of the acceptability limits, are to be approved by the Manufacturer. CBM techniques not included in this Section may be accepted if they are proposed or established by the Manufacturer of a machine.

Guidance on CBM can be found in the Tasneef "Guide for the Application of Condition Based Maintenance in the Planned Maintenance Scheme".

2 Roles and Responsibilities

2.1 Owner/ Operator

At the time of the request for approval of the machinery Planned Maintenance Scheme, the Owner/Operator is to submit the CBM details as specified in [3] and [4], the techniques and the tools that will be employed; for onboard instrumentation, the operating manual and user's guide supplied by the Manufacturer are to be part of the platform’s maintenance documentation.

The strategy for the items subjected to CBM is to be computer based and a minimum number of readings is to be taken during the period between annual surveys. CBM does not absolve the platform personnel of the responsibility to perform visual inspections of the items.

The reading points are to be clearly marked and identified by Memory Identification Card.

The documentation is also to include the responsibility chart of the dedicated human resources for CBM, which may be internal (i.e. onboard or shoreside staff) or external (professional engineering companies), and the relevant qualifications.

The CBM strategy, inclusive of the description of the tools to be used, dedicated personnel, measurements to be taken etc., is to be an integral part of the PMS survey and is to be included in a dedicated section of the PMS scheme.

2.2 Tasneef

The Planned Maintenance Scheme will be reviewed for approval with particular reference to the CBM proposals. Tasneef reserves the right to require the baseline measurements for a period of at least six months, according to the age and condition of the platform's machinery.

Tasneef's Surveyors retain the right to test or open up the machinery, irrespective of the presence of CBM, if deemed necessary.

2.3 Responsible person onboard

The presence of a CBM does not absolve the responsible personnel from their duties, including the responsibility for interventions on machines according to his experience and judgment. The responsible person is to ensure that the CBM parameters are recorded at the agreed intervals. This is to include an initial or "baseline" set of readings, against which further data can be compared.

2.4 Annual survey

The requirements for an annual survey of the machinery maintenance and monitoring records are the same as those given in [10.3.2]. At the annual survey the Chief Engineer is to make available the following maintenance and monitoring records, in addition to those specified in [10.3.2]:

- CBM records for each item to be credited for class. The records are to indicate where acceptable limits have been exceeded and what actions were taken.

• Calibration certificates for instrumentation used to take measurements, if applicable.

The responsibilities of Tasneef's Surveyors at the annual survey, additional to those described in [10.3.2], are:

a) to examine the machinery and monitoring records in sufficient depth to ensure that the scheme has been operated correctly and that the machinery has functioned satisfactorily since the previous survey.

b) to examine the CBM records to verify that the parameters lie within the specified limits (or, in the case of a malfunction in a machine, to check the readings taken just before the malfunction for information to be used in the preparation of the relevant Damage Report). Baseline condition data are to be compared with subsequent readings to ascertain the trend characteristics. Tasneef's Surveyors may require confirmatory readings on available running machinery to be taken for comparison with the platform's records.

c) to check the calibration certificates for CBM instrumentation and probe the personnel's ability to manage CBM tools and records.

3 CBM criteria for main machinery

3.1 Diesel engines for main electrical generation

Tab 1 lists the minimum checks to be carried out.

Table 1

Parameters to be monitored	Diesel engine for electric power generation	
	Request	Minimum periodicity
Power output **(1)**	Yes	Weekly
Running hours	Yes	Weekly
Rotational speed	Yes	Weekly
Indicated pressure diagram (where possible) or pressure-time curves	Yes	Weekly
Fuel oil temperature and/or viscosity	Yes	Weekly
Charge air pressure and temperature at receiver	Yes	Weekly
Exhaust gas temperature for each cylinder	No	-
Exhaust gas temperature before and after the turbochargers	Yes	Weekly
Temperatures and pressure of engine cooling system	Yes	Weekly
Temperatures and pressure of engine lube oil system	Yes	Weekly
Rotational speed of turbochargers **(2)**	Yes	Weekly
Bearing vibrations of turbochargers **(2)**	Yes	Monthly
Results of lube oil analysis	Yes	6 months
Crankshaft deflection readings	Yes	6 months

Analysis of the fluid of crankshaft torsional vibration damper (if viscous type) according to maker's instructions	Yes	6 months or as per maker's instruction
Temperature of main bearings and crankcase pressure	Yes	Weekly Where available
Fuel oil analysis (ISO 8217:2005)	Yes	At every bunkering
Engine load (%)	Yes	Weekly
Alternator load (kW)	Yes	Weekly
Inspection of bedplate structure/ chocks / down bolts	Yes	6 months
Vibration of bearings of diesel generator and alternator	Yes	4 months
(1) To be read by a torquemeter or other equivalent instrument, or through the governor output, or by taking the position of the rack **(2)** Reading points of turbocharger's rotational speed and bearing vibrations are to be identified according to the Manufacturer's instructions **Note 1:** If the Owner opts to monitor the turbocharger(s) independently of the diesel engine, the following measures are to be taken on a weekly basis as a minimum: • Exhaust gas temperature before/after turbocharger • Charge air pressure at receiver • Turbocharger rotational speed and vibration. Reading points are to be identified according to the Manufacturer's instructions.		

3.2 Emergency diesel generator

The parameters to be checked are the following:

- calibration and test of fuel nozzles
- measurement of compression of cylinders
- fuel oil filter cleaning
- lube oil analysis.

The measures are to be taken at five-year intervals as a minimum.

3.3 Electric motor with associated frequency converter

Tab 2 lists the minimum checks to be carried out.

Table 2

Method	Requirement
Performance Monitoring	Propulsion Motor: Continuous or periodical monthly monitoring of: • Supplying current on main switchboard (phases and windings) • Converter current (phases and windings) • Feeding transformer highest winding temperature • Motor highest winding temperature • Rotational speed • Encoder for rotor position check • Bearing temperature at drive end (D.E.) • Bearing temperature at non-drive end (N.D.E.) • Cooling air in temperature • Cooling air out temperature • Highest cubicle temperature • Converter heat exchanger temperatures • Motor D.E. and N.D.E. oil leakage detection Propulsion system insulation resistance: every 12 months
Vibration Monitoring	Periodical monitoring of motor bearings. No less than one per month

Lubricant Analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months
Oil Transformer analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months

3.4 Gas turbines

Tab 3 lists the minimum checks to be carried out. The periodicity of the measures is to be defined by the Manufacturer. In addition, shut-down systems and safety devices are to be checked at Annual Survey.

Table 3

Method	Requirement
Visual Inspection	Periodical inspection of : • intakes and exhaust ducts • inlet guide vanes • compressor (first stage) • casings • auxiliaries • running clearances (as far as practicable)
Borescope	Periodical inspection of : • compressor stators • guide vanes and blades • combustion chambers • turbine nozzles and blades
Vibration Monitoring	Continuous monitoring and trend analysis of gas turbine rotor bearing vibration
Lubricant Analysis	Periodical inspection of : • magnetic particle detectors • oil filters Regular sampling of lube oil, laboratory testing Alternatively, a fixed analyser allowing continuous oil debris monitoring can be fitted in the section from the oil return line to the filter, provided that it does not affect the oil flow in any way
Fuel analysis	Regular sampling according to ISO 8217: 2005
Performance monitoring (usually provided by the automation system associated with the package)	Continuous monitoring and trend analysis of : • compressor (inlet/exit temperature, discharge pressure, speed) • turbine (inlet temperature, speed) • engine breather temperature • fatigue counter

3.5 Gearing

Tab 4 lists the minimum checks to be carried out.

Table 4

Method	Requirement
Condition Monitoring	Gear wheels, pinions, shafts, bearings, couplings, power clutch and driven pumps are to be inspected at every dismantling. The following checks are required: • gear backlash and pinion/shaft diametric clearance • shaft seal tightness. It may be accepted that gears and roller bearings are inspected without dis- mantling, as far as practicable, by means of non-invasive diagnostic techniques. Moreover, the following parameters are to be checked weekly: • bearing lubricating oil pressure • rotational speed.
Vibration Monitoring	Periodical or continuous monitoring of bearings. No less than once every 4 months
Lubricant Analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months

3.6 Steam turbines

For the main and auxiliary steam turbines the parameters to be checked are the following:

- turbine bearing vibrations (continuous or monthly readings)
- power output (by torquemeter or other equivalent device; otherwise the number of nozzles, the inlet steam pressure and the pressure in the nozzle chamber are to be available for the power appraisal) (continuous or weekly readings)
- Rotational speed (continuous or weekly readings)
- Periodical measurement of rotor axial position using external indicators (monthly)
- Continuous or periodical monthly vibration monitoring of turbine bearing housing
- Plant performance data, i.e. steam conditions at the inlet and outlet of each turbine, saturated, superheated and desuperheated steam conditions at the outlet of boilers, condenser vacuum, sea temperature.

Lube oil analysis is requested at least once every six months.

The following additional visual inspections or checks are required:

- boiler water analysis records every six months
- inspection of rotor bearings, thrust bearings, coupling and casing axial expansion arrangements at every dis- mantling
- inspection of final low pressure and astern blading at every dismantling.

4 Miscellaneous systems and equipment

4.1 General

This item summarises the minimum requirements for the most common machinery types that can be fitted on the topside. In addition to the listed parameters to be checked, periodical visual inspections are to be scheduled.

4.2 Cooling system equipment: centrifugal pumps, electric motor driven

Periodical check of:

- rotational speed
- vibration monitoring with associated readings
- pressure at suction/delivery
- electric motor current.

Note 1: for engine driven pumps, vibration readings are always to be taken at the same engine speed (rpm).

Minimum frequency of checks:

- monthly: sea water cooling pumps, high and low temperature fresh water cooling pumps, general service low temperature pumps
- every four months: preheating high temperature cooling system pumps.

4.3 Lubrication oil system: worm/gear pumps, electric motor driven

Periodical check of:

- rotational speed
- vibration monitoring with associated readings
- pressure at suction/delivery
- electric motor current.

Note 1: for engine driven pumps, vibration readings are always to be taken at the same engine speed (rpm).

Minimum frequency of checks: monthly.

4.4 Fuel oil system: booster/supply gear pumps, electric motor driven

Periodical check of:

- rotational speed
- vibration monitoring with associated readings
- pressure at suction/delivery
- electric motor current.

Note 1: for engine driven pumps, vibration readings are always to be taken at the same engine speed (rpm).

Minimum frequency of checks: monthly.

4.5 Compressed air system

For the following machine types:

- starting air compressor, reciprocating, electric motor driven
- general service air compressor, piston/screw type, electric motor driven
- auxiliary blower electric motor driven,

periodical check of:

- rotational speed
- vibration monitoring with associated readings
- delivery pressure
- electric motor current, are required.

Minimum frequency of checks: every three months.

4.6 Purifying system : fuel oil and lube oil purifiers

The following checks are required on a monthly basis as a minimum:

- vibration monitoring at reading point indicated by maker (vibration limits suggested by Manufacturer, because of high speed)
- bowl rotational speed
  reading b) every three
  months as a minimum:
- vibration monitoring periodical readings and visual
- inspection of fuel oil or lube oil supply gear pumps.

4.7 Miscellaneous liquid transfer pumps

For the following equipment types, electric motor driven:

- fuel oil transfer pumps (worm, gears);
- fresh water transfer pumps (centrifugal);
- lube oil transfer pumps (worm, gears),

the following checks are required, at least every three months:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

4.8 Fire and general service pumps

For the following equipment types, electric motor driven:

- fire pumps (centrifugal);
- general service pumps (centrifugal),

the following checks are required, at least every three months and as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

4.9 Other pumping system

For the following equipment types, electric motor driven:

- centrifugal pumps
- reciprocating pumps,

the following checks are required, at least on a monthly basis and as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

4.10 Potable water system: centrifugal pumps, electric motor driven

The following checks are required, at least every three months and as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

4.11 Steam system

For the following equipment type:

- main boiler feed water multistage centrifugal pumps, steam turbine driven,

the following checks are required, at least every three months:

- rotational speed,
- steam pressure/temperature at turbine inlet/outlet
- pump suction/delivery pressure
- lubricating oil analysis
- pump and turbine bearing vibration monitoring.

For the following equipment types, electric motor driven:

- auxiliary boiler feed water, single stage or multistage centrifugal pumps
- exhaust boiler circulating centrifugal pumps
- fuel oil pumps of main and auxiliary boilers
- boiler forced draught ventilators, electric motor driven,

the following checks are required, at least every three months, as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

For the following equipment type, electric motor driven:

- boiler forced draught ventilators, electric motor driven,

the following checks are required, at least every three months, as far as possible in the same working conditions:

- vibration monitoring with associated readings
- electric motor current.

4.12 Fresh water generator

For the following equipment type, electric motor driven:

- feed, cooling, injector sea water centrifugal pumps

the following checks are required, at least on a monthly basis:

- vibration monitoring with associated readings
- rotational speed
- electric motor current
- suction/delivery pressure.

The above checks also apply for distillate and condensate centrifugal pumps, at least every three months.

4.13 Air conditioning and refrigeration system

For the following equipment type, electric motor driven:

- screw, piston or centrifugal compressor for HVAC, electric motor driven, direct or belt transmission,

the following checks are required, at least every three months:

- vibration monitoring with associated readings
- rotational speed
- electric motor current
- suction/delivery pressure.

4.14 Cargo systems

For centrifugal large size cargo pumps, electric motor or steam turbine driven, the following checks are required, at least every three months:

- vibration monitoring with associated readings
- rotationa l speed
- electric motor current
- suction/delivery pressure.

Note 1: the instruments employed are to be intrinsically safe.

For inert gas blowers (radial, centrifugal or rotary), electric motor driven, the following checks are required, at least on a monthly basis:

- vibration monitoring with associated readings
- rotationa l speed
- electric motor current.

4.15 Ventilation system

For ventilators, the following checks are required, at least every three months:

- vibration monitoring with associated readings
- rotationa l speed
- electric motor current.

Note 1: the following equipment may be difficult to reach and may require remote installations with cables placed outside:

- HVAC units of accommodation systems
- ventilators of various type for engine rooms, pump room, stores, purifier room with ventilator on shaft
- ventilators for evacuating exhaust from ro-ro car spaces.

4.16 Hydraulic power packs

For the following components of hydraulic power packs:

- supply pumps for hydraulic power packs
- hydraulic cargo pumps
- hydraulic pump for servo units,

the following checks are required, at least every three months:

- vibration monitoring with associated readings
- electric motor current
- suction/delivery pressure.

Note 1: the instruments are to be intrinsically safe; moreover, if the cargo pumps are submerged, a fixed installation is to be provided to allow vibration readings from a remote position.

4.17 Liquefied gas systems

For compressors of the refrigerating cycle, electric motor driven, the following checks are required, at least every three months:

- vibration monitoring with associated readings
- electric motor current
- suction/delivery pressure.

4.18 Electrical switchboard

For low voltage panels and medium voltage panels (if practicable), a thermographic inspection is required at least yearly, in the conditions of maximum expected load. The same techniques may also be applied to cables, piping or even to machinery parts to extract information additional to the other CBM techniques.

APPENDIX 2 CLASS REQUIREMENTS AND SURVEYS OF MOTHBALLED PLATFORMS

1 General

1.1 General requirements

1.1.1 In order to maintain its class during a normal operation period, a platform is to be submitted to the surveys described in Chapter 3, at their due dates and to the satisfaction of Tasneef, and is to be free of overdue surveys and conditions of class during the considered period.

1.1.2 When a platform stops trading and is put out of commission for a certain period, i.e. is mothballed, the normal survey requirements may no longer apply provided that the Owner notifies Tasneef of this fact. The Owner is also to submit a mothballing maintenance program to Tasneef for approval.

1.1.3 The mothballing maintenance program includes:

- the safety conditions to be kept throughout the mothballing period
- the measures taken to preserve the maintenance of the platform throughout the mothballing period
- the survey requirements to be complied with for mothballing, maintenance of class in mothballing and re-commissioning.

2 Safety conditions

2.1 General

2.1.1 Power supply

Adequate power supply (electric, compressed air and/or hydraulic) is to be supplied, or readily available, all around the clock, either from independent means on board the platform or from shore.
The following safety conditions are to be kept throughout the mothballing period.

2.1.2 Manning

If the platform is manned, means of watching are to be provided. The number of the watch personnel will depend on the size of the platform, the shore assistance available in case of fire, leakage or flooding, the maintenance required to provide adequate preservation. A permanent shore communication installation (radio, telephone) is also to be available.

2.1.3 Fire protection and fire fighting

Automatic fire alarm systems, where provided, are to be in working order and in operation.
Passive protection system is to be in order.

2.1.4 Protection against explosion

Process and piping systems are to be cleaned and ventilated to prevent gas from forming any pockets.
An inert gas system in operation is recommended.
All flammable materials, sludge, etc. are to be removed from the platform's bilge, tanks , engine room, pump rooms and similar spaces.
Hot work is not be carried out during mothballing, unless special precautionary measures are taken.

2.1.5 Safety equipment

All the equipment usually recommended for the safety of the watch personnel is to be provided, kept in working order and tested regularly.

The usual life-saving equipment such as liferafts, life-buoys, breathing apparatus, oxygen masks and distress signals is to be provided and made accessible.
The requirements of the flag Administration and of the local port authorities of the platform are usually to be applied.

2.1.6 Emergency power

The emergency source of power, emergency generator with its auxiliaries, UPS's and instrument air system are to be kept in working order and tested weekly.

3 Preservation measures for mothballing and maintenance

3.1 General

3.1.1 A mothballing log-book is to be kept on board, in which the maintenance work and tests carried out during the mothballing period are to be entered with the corresponding dates. The nature and frequency of the maintenance, inspections and tests are also to be defined in the lay-up log book.

3.1.2 The following measures for preservation and maintenance during the mothballing period are to be taken by Owners according to the process systems, machinery installations and the specific cases of mothballing conditions.

3.2 Structure

3.2.1 The same policy of the platforms in operation applies. Moreover, the coating of topside, access doors or hatches or covers on exposed structures, is to be maintained in satisfactory condition.

All accesses leading to internal spaces are to be kept closed. All vent pipes and ventilation trunks are to be kept closed.

3.3 Internal spaces

3.3.1 Tanks and holds are to be emptied, cleaned and kept dry.

3.3.3 Fuel oil and lubricating oil tanks are to be drained regularly.

Lubricating oil analysis is to be performed regularly and the oil renewed when the result is not satisfactory. Prior to being refilled, tanks are to be cleaned.
Empty lubricating oil tanks are to be cleaned and kept dry. Fresh water or distilled water tanks are to be kept full or empty. Empty tanks are to be cleaned and kept dry. Where cement wash is used as a coating, this is to be examined and, if necessary, repaired prior to filling.

3.3.4 The bilge in engine rooms is to be cleaned and kept dry.

Sea inlet and outlet valves not in use are to be kept closed.

3.4 Topside fittings

3.4.1 Lifting appliances, capstans and winches are to be regularly greased and tested once a month.

All wire cables are to be kept greased.

Cargo piping on topside is to be drained, blown through if deemed necessary and kept dry by opening up drains.

Electrical machinery and apparatuses are to be protected by watertight covers.

3.5 Machinery

3.5.1 Machinery spaces

The air temperature inside the machinery spaces is normally to be kept above 0°C.

Humidity is to be kept as low as possible and within acceptable limits.

3.5.2 Machinery - General

Exposed mechanical parts of machinery are to be greased.

All rotating machinery such as diesel engines, reciprocating engines, pumps, turbines, electric motors and generators are to be turned at regular intervals with a limited number of revolutions (the lubricating oil system should be put in operation or proper priming applied). Units are not to be stopped in the same position as the previous one.

Bearing boxes are to be emptied, cleaned and refilled with new oil.

3.5.3 Main turbines

Turbines are to be kept dry.

All steam inlets are to be sealed.

Expansion arrangements (sliding feet) are to be suitably greased.

Electric heaters are to be put inside the turbines. Heat drying is to be made in open circuit, all valves shut and gland closing devices withdrawn.

Turbines are to be turned weekly, the lubricating oil system being put in service. The shaft line is to be stopped after turning an integer number of revolutions plus one quarter of a revolution.

3.5.4 Reduction gears

For large reduction gears, a fan activating the circulation of hot air in closed circuit with air hoses is to be fitted (intake at lower part of casing and discharge at upper part).

3.5.5 Auxiliary turbine-driven machinery

Stators are to be drained and kept dry. Shaft sealing glands are to be lubricated.

Lubricating oil is to be analyzed and renewed when deemed necessary. Prior to oil renewal, the oil casings are to be cleaned.

Exhaust steam pipes are to be kept dry. Stuffing boxes are to be dismantled.

Turbines are to be turned weekly an integer number of revolutions plus one quarter of a revolution.

3.5.6 Condensers and heat exchangers

Condensers and heat exchangers are to be drained and kept dry.

Desiccant is to be placed in steam spaces. Water sides are to be washed with fresh water.

The condition of the zinc anodes is to be periodically checked.

When tubes are fitted with plastic or fibre packing, water sides are to be filled with alkaline distilled water.

When tubes are expanded or fitted with metal packing, water sides are to be provided with desiccants and kept dry.

3.5.7 Auxiliary machinery

Air receivers are to be drained, opened up and cleaned. Pressure relief valves are to be cleaned and slightly lubricated.

Air compressor crankcases are to be drained, cleaned and refilled with clean oil. Cylinders and valves are to be lubricated. Coolers are to be drained and dried. Air drains are to be opened and the system dried.

Air start lines are to be drained and dried.

Hot-wells/return tanks are to be drained and dried. Deaerators are to be drained and dried.

Feed pumps and extraction pumps are to be drained and dried.

Air ejectors are to be drained and dried.

Main circulation pumps are to be drained and dried. Evaporators are to be drained, cleaned and dried.

3.5.8 Piping

Pipes not in use are to be drained, kept dry and inerted with nitrogen under slight overpressure according to the mothballing plan..

3.5.9 Diesel engine

Daily tank fuel oil outlet pipes and all injection equipment are to be filled with filtered gas oil.

Fresh water circuits are to be filled with water mixed with rust inhibitors. Fresh water pH is to be checked monthly.

Oil of hydraulic regulators is to be replaced. Sea water cooling pipes are to be drained. Crankcases are to be provided with desiccant.

Starting valves are to be lubricated (internally and externally).

Motor oil is to be sprayed in cylinders and on all external parts liable to corrosion.

Cams and cylinders are to be motor oil sprayed monthly. Turbo-compressor/charger ball bearings are to be oil sprayed and rotated for an integer number of revolutions plus one quarter of a revolution.

Engine air inlets and exhaust gas pipes are to be sealed. Scavenge spaces are to be cleaned.

Engines are to be turned weekly.

3.6 Electrical installations

3.6.1 Main and secondary switchboards, sub-feeder panels, fuse panels and starters are to be made tight. Desiccant is to be provided.

Contacts of relays, breakers and switch-breakers are to be coated with neutral vaseline.

Bearings of generators are to be cleaned of old grease and protected with new oil or grease.

Carbon brushes are to be lifted off their commutations.

3.6.2 Electrical insulation of each item is to be kept at a minimum 200000 Ω and general insulation is to be not less than 50000 Ω. Local electric heating may be necessary to improve the level of insulation, particularly in the generators/alternators and large motors.

A megger test is to be performed regularly.

3.8 Boilers

3.8.1 Smoke sides of boilers are to be swept, washed clean with basic hot water and hot air dried.

3.8.2 Water and steam sides should preferably be preserved using the dry method, keeping the moisture at the lowest possible level, the ideal level being between 30% and 35%. It is advisable to ensure that no residual water remains to cause rapid corrosion. Drum doors are to be kept closed.

In other cases, it is advisable to keep the boilers, superheaters and economisers filled with water having a pH around

10,5. Hydrazine hydrate treatment of the water is preferable to reduce risks of corrosion caused by dissolved oxygen. The water is to be regularly analysed.

3.8.3 Air heaters are to be cleaned and kept dry.

Uptake, shell and fan outlets are to be cleaned and kept closed with watertight hoods.

Burners are to be dismantled, and atomisers greased. Desiccant is to be provided in furnaces where deemed necessary.

Expansion arrangements (sliding feet) are to be suitably greased.

The internal condition of boilers is to be checked every three months.

3.8.4 Boilers may also be preserved sealed with inert gas (nitrogen), provided that cocks and valves are tight and the installation allows an internal pressure of at least 0,05 bar to be maintained to prevent air penetration. Regular checks of the overpressure are to be carried out and results recorded in the log-book.

3.9 Automation equipment

3.9.1 Recommendations for electronic components are the same as those given for electrical installations, with the additional recommendations of the manufacturers.

For pneumatic parts the manufacturers' recommendations are to be followed and the system is to be checked regularly.

Pressure, temperature or level sensors are generally not affected by damage when not used. However, when available, the manufacturers' recommendations are to be followed.

4 Surveys

4.1 Mothballing survey

4.1.1 At the beginning of the mothballing period, a survey is to be carried out whose scope is to verify that the safety conditions and preservation measures are in accordance with the program agreed by Tasneef.

4.1.2 Upon satisfactory completion of this survey, an endorsement to confirm that the platform has been placed in mothballing is entered on the Certificate of Classification, which is subsequently to be kept on board.

4.2 Annual mothballing condition survey

4.2.1 As described in [16], an annual mothballing condition survey is to be performed in lieu of the normal annual class surveys. The purpose of this survey is to ascertain that the lay-up maintenance program agreed between Society and Owner/operator implemented is continuously complied with.

4.2.2 It is to be checked that the arrangements made for the mothballing are unchanged and that the maintenance work and tests are carried out in accordance with the maintenance manual and recorded in the mothballing log-book.

4.2.3 Upon satisfactory completion of the survey, the Certificate of Classification is endorsed.

4.3 Re-commissioning survey

4.3.1 Owners are to make the necessary arrangements to remove the temporary mothballing installations provided for preservation measures and the protective materials and coatings (oil, grease, inhibitors, desiccants), before the survey is commenced.

It is the Owners' responsibility to verify that the platform parts that are not covered by class are reactivated in satisfactory operational condition.

4.3.2 The scope of the re-commissioning survey is to include:

- a general examination of topside fittings, safety systems, machinery and electrical installations (including boilers whose survey is not due);
- all periodical surveys due at the date of re-commissioning or which became overdue during the mothballing period;
- dealing with the recommendations due at the date of re- commissioning or which became due during the mothballing period.

In all cases where the Owner elects to carry out the "next due" renewal survey, the periodical machinery surveys, due or which become overdue during the mothballing period, will be replaced by this one.

4.3.3 For the hull the following is to be carried out:

- examination of topside plating
- overall survey of all cargo tanks/holds
- function tests of bilge systems.

4.3.4 For the topside fittings the following is to be carried out:

- where possible, examination of deck piping under working pressure
- function tests of class items
- checking inert gas installation under working condition.

4.3.5 For machinery installations the following is to be checked:

- the analysis of lubricating oil of main engines, auxiliary engines, reduction gears,
- the general condition of crankcase, crankshaft, piston rods and connecting rods of diesel engines
- the crankshaft deflections of diesel engines. In addition when engines have been mothballing for more than two years, one piston is to be disconnected and one liner is to be removed for examination. Dismantling is to be extended if deemed necessary
- the condition of blades of turbines through the inspection doors
- the condition of the water side of condensers and heat exchangers
- the condition of expansion arrangements
- the condition of reduction gears through the inspection doors
- the condition after overhauling of pressure relief devices
- the test of bilge level alarms, when fitted.

4.3.6 The main and emergency electrical installations are to be tested. The parallel shedding of main generators and main switchboard safety devices are to be checked. A megger test of the electrical installation is to be performed.

4.3.7 For the fire prevention, detection and fire-fighting systems, the following are to be examined and/or tested:

- fire detectors and alarms
- conditions of passive protection
- ESD system.

4.3.8 The automated installation is to be checked for proper operation.

4.3.9 When classed, the installations for refrigerated fluids are to be examined under working conditions. Where the mothballing period exceeds two years, representative components of the platform are to be dismantled.

4.3.10 For liquefied gas systems, the following is to be carried out:

- inspection of the primary barrier in tanks
- for membrane tanks, a global gas test of tanks whose results are to be compared with those obtained at ship's delivery
- testing of gas piping at working pressure using inert gas.

A Surveyor of Tasneef is to attend the first cooling down and loading of the system.

4.3.11 For other specific classed installations, the Owner/operators are to submit a survey program to Tasneef.

4.3.12 Upon satisfactory completion of the surveys, an endorsement to confirm the carrying out of all relevant surveys and the re-commissioning of the platform is entered on the Certificate of Classification.

RULES FOR THE CLASSIFICATION OF STEEL FIXED OFFSHORE PLATFORMS

Part B

Chapters **1 2 3 4 5 6**

CHAPTER 1 GENERAL PRINCIPLES

1 General

1.1 Safety requirements

1.1.1 Platforms are to be designed and constructed so as to ensure an acceptable standard with regard to the safety of life at sea and to the prevention of environmental pollution and of possible major economic losses during all phases of the design life.

A platform is considered to have an acceptable level of safety when it is designed, constructed and inspected in compliance with the requirements of these Rules as well as with those of supplementary codes and standards mentioned in [1.4].

1.2 Exposure levels

1.2.1 With reference to ISO 19902:2007, fixed offshore platforms can be categorized by different exposure levels, according to which assessment criteria tailored to the intended service of the platform are determined.

Three levels of exposure are determined (ref. Subclause 6.6 ISO 19902:2007) in consideration of:

- Life safety categories:
  - o S1 : Manned non-evacuated;
  - o S2 : Manned evacuated;
  - o S3 : Unmanned;
- Failure consequence categories:
  - o C1 : High consequence;
  - o C2 : Medium consequence;
  - o C3 : Low consequence.

1.2.2 In order to select the appropriate category for both life safety and failure consequence for the offshore platform under examination, reference can be made to the criteria reported in ISO 19902:2007, Subclauses 6.6.2 and 6.6.3 respectively.

The three exposure levels are therefore determined as a combination of the two sets of categories (ref. Table 6.6-1 ISO 19902:2007) as reported in the following Table 1.1:

Life Safety Category	Consequence Category		
	C1	C2	C3
S1	**L1**	**L1**	**L1**
S2	**L1**	**L2**	**L2**
S3	**L1**	**L2**	**L3**

Table 1.1 – Exposure Level determination.

1.2.3 The applicable exposure level is to be determined by the owner prior to the design of a new platform or the assessment of an existing platform, and the platform will be certified accordingly.

1.2.4 The assigned exposure level can be modified during the service life following to modification in platform characteristics that affect life safety or consequence category.

1.3 Functional requirements

1.3.1 The serviceability of the platform, i.e. the aptitude of the platform to be properly operated in performing its design service, may require special design criteria.

The Designer or the Owner may specify functional requirements which are additional to those of these Rules.

1.4 Supplementary codes or standards

1.4.1 The requirements of these Rules are to be applied together with those of recognised design codes or standards.

In particular reference shall be made to the ISO series listed in Part A, Chapter 1.

Standards for testing of materials, production of materials, etc. are to comply, to the satisfaction of Tasneef, with standards taken as a basis for the platform design.

1.4.2 Supplementary codes or standards used in the design are to be submitted to Tasneef for prior approval.

In the case of discrepancies between the requirements of codes or standards used and those of these Rules, Tasneef may accept the former provided that, in its opinion, they ensure a global safety level equivalent to or higher than that resulting from the compliance with these Rules.

Preference will generally be given to codes or standards developed and used in the Country where the platform is to be installed.

1.5 Documentation to be submitted

1.5.1 General

For each platform for which the Classification is requested, according to the general principles introduced in Part A, Chapter 2, Section 2, the documentation described in [1.5.2] is to be submitted to Tasneef before starting the actual construction or prior to installation, whichever is applicable.

When specific certification is required, according to the possible different tasks described in Part A, Chapter 2, [3.2], relevant documentation is to be submitted according to the general principle introduced in Part A, Chapter 2, [3.3].

1.5.2 Documentation for the classification of the structure

In general, the following documentation is to be submitted:

a) drawings and specifications covering the structure and all protective systems such as to permit the evaluation of strength, durability and suitability to perform the design service of the platform;

b) specification of anticipated environmental conditions and loads assumed for design and scantling of the platform;

c) analyses and calculations carried out to prove that the proposed constructional features are adequate to provide the required strength, durability and design service.

The documentation is subdivided as follows (as further specified in [1.5.3], [1.5.4] and [1.5.5] respectively):

a) documentation for information, to define the purpose and the functions of the platform. This documentation is not subject to approval but it is deemed necessary for a proper check and evaluation;

b) documentation for evaluation, concerning design, criteria, reports on environmental conditions and loads, materials, specifications, analysis and calculations carried out to demonstrate that the proposed structure meets the requirements of these Rules. Tasneef may require further information after evaluation of this documentation;

c) documentation for approval, consisting of design and constructional drawings and specifications in compliance with the documentation listed under items a) and b).

According to the specific third party role, as introduced in Part A, Chapter 2, [7.1.1], the construction, transportation and installation phases are to be supervised by Tasneef Surveyors in order to check the compliance of the platform with the approved drawings, procedures and specifications.

1.5.3 Documentation for information

Such documentation is to include the following information:

a) geographical location and orientation of the platform;

b) primary function of the structure;

c) general arrangement and functioning of the platform;

d) design life;

e) description of the main construction and installation phases;

f) location of construction sites;

g) description of calculation programs used for design;

h) construction method;

i) construction tolerances.

1.5.4 Documentation for evaluation

Such documentation is to include the following details concerning:

a) environmental factors:

1) sea depth;
2) astronomical tides;
3) storm tide;
4) waves;
5) marine fouling;
6) wind;
7) salinity;
8) currents;
9) earthquakes;
10) ice;
11) temperature;
12) corrosivity;
13) design values of the environmental factors listed above;
14) analytical or experimental evaluation of the environmental forces;

15) evaluation of design feasibility on the basis of the environmental data;
16) hydrostatic stability and motion characteristics during relevant marine operation;

b) soil and foundations:
   1) investigation of sea bed conditions, topography, obstructions, etc.;
   2) investigation of geology and soil conditions including both in situ and laboratory tests;
   3) design values of soil parameters;
   4) foundation stability analysis, including:
      - sliding, bearing capacity, failure in cyclic loading;
      - axial and lateral resistance of piles;
      - sea floor stability during transient operations;
   5) penetration of skirts, ribs, dowels, etc.;
   6) pile driveability;
   7) soil-structure interaction during platform installation and operation;
   8) evaluation of scouring;

c) material properties:
   1) structure steel;
   2) grouting materials (permanent ballast, pile grouting, etc.);
   3) other materials;
   4) protection against corrosion;

d) static and dynamic structural analysis for all design phases:
   1) basic assumptions and method of analysis;
   2) static and dynamic analytical models;
   3) calculation of loading effects;
   4) natural frequencies and dynamic response;

e) structural design:
   1) design procedure;
   2) global stability;
   3) capacity to withstand the ultimate load;
   4) suitability to perform the service operation;
   5) fatigue strength;
   6) strength to withstand accidental loads;
   7) special structural details;
   8) instrumentation and data recording systems;

f) miscellaneous items:
   1) additional regulations and codes (see [1.4]);
   2) operational requirements;
   3) demonstration of reliability of computer programs used for design;
   4) calculations of temperature distribution in the structure, where applicable.

1.5.5 Documentation for approval

Such documentation is to include the following:

a) drawings showing structural arrangements and relevant scantlings, and indicating the properties of the materials employed;
b) construction specifications;
c) details of welded and, if any, bolted connections;
d) detailed description of all production and construction procedures affecting the strength and durability of the platform;
e) description of procedures for transporting, ballasting and setting the platform jacket;
f) description of procedures for installation of the platform and its foundations;
g) description of protection system against corrosion;
h) description of protection system against scouring;
i) procedures for improvements of foundation conditions, if applicable;
j) description of instrumentation systems for monitoring of the structure during its installation and operating life, if applicable;
k) description of methods or procedures to be used for inspections and maintenance of the structure.

2 Methods of analysis and calculation

2.1 General

2.1.1 The safety verification of the platform structure is to be performed by checking that stresses, generated by the different loads possibly acting on the platform are not exceeding resistance levels of the structural components that are to be defined with reference to a specific set of limit states.

2.1.2 According ISO 19902:2007 Subclause 7.2 and ISO 19900:2002 Subclause 5.1.2, four categories of limit states can be defined:

a) Ultimate limit states (ULS), which generally correspond to the resistance to maximum applied actions;

   (ref. ISO 19900:2002, Subclause 5.1.3);

b) Serviceability limit states (SLS), which correspond to the criteria governing normal functional use;

   (ref. ISO 19900:2002, Subclause 5.1.4);

c) Fatigue limit state (FLS), which corresponds to the accumulated effect of repetitive actions;

   (ref. ISO 19900:2002, Subclause 5.1.5);

d) The accidental limit states (ALS), which corresponds to situation of accidental or abnormal events.

   (ref. ISO 19900:2002, Subclause 5.1.6).

2.1.3 For each limit state, design situation shall be determined and an appropriate calculation model shall be established.

ISO 19902:2007 Clause 7 outlines the overall requirements for:

a) incorporating limit states *(ref. ISO 19902:2007, Subclause 7.2)*;

b) determining design situations *(ref. ISO 19902:2007, Subclause 7.3)*;

c) structural modelling and analysis *(ref. ISO 19902:2007, Subclause 7.4)*;

d) design of the structure *(ref. ISO 19902:2007, Subclauses 7.5 to 7.12)*.

2.2 Determination of loading effects

(ref. ISO 19902:2007, Subclause 7.4 and Clause 12)

2.2.1 The determination of forces, moments, stresses and strains as well as the definition of corresponding limit values are to be based upon accepted principles of static analysis, dynamic analysis and strength of materials.

The determination of loading effects is to be based on the theory of elasticity.

Methods based on the theory of plasticity will be specially considered by Tasneef.

2.2.2 Physical and mathematical models used to analyse the platform and the idealisations of structures and of loadings are to be deemed acceptable by Tasneef and are to simulate and describe satisfactorily the behaviour of the actual structure and the anticipated relevant environmental conditions. Reasonable simplifications concerning the structural analysis may be introduced, provided structures and/or loading patterns offer consistent symmetrical and skew-symmetrical characteristics.

2.2.3 Possible effects of non-linearity in the geometry or materials which may significantly affect the safety of the structure are to be carefully considered.

The influence of geometrical imperfections on the behaviour of the structure is also to be considered.

2.2.4 The effects of cyclic loads, which may cause damage due to fatigue, are to be determined in terms of magnitude and number of cycles; i.e. a long term distribution analysis of alternate stress magnitudes on the basis of the stress fluctuation anticipated during the design life of the platform.

The dynamic effects of cyclic loads, including local vibrations caused by vortex shedding phenomena, are to be considered.

2.2.5 The response of structures subject to loads which may be considered random may be evaluated by either deterministic or statistical methods.

A deterministic analysis is to be based on loads as defined in Part B, Chapter 3.

A statistical analysis is to be based on spectra, distribution of sea states, duration of extreme load periods etc. deemed acceptable by Tasneef.

2.2.6 The dynamic statistical analysis of the platform subject to wave actions is normally required when natural frequencies of the structure are close to those of waves having significant energy level (ref. ISO 19902:2007, Subclause 9.8).

2.2.7 Dynamic loading effects are to be determined using recognised methods of analysis and realistic assumptions with regard to loads, material properties and analytical models.

In general, if the natural frequency of the platform is lower than 3 sec, a quasi-static approach is allowed by the introduction of equivalent quasi-static action representing the dynamic response caused by extreme wave conditions *(ref. ISO 19902, Subclauses 9.4 to 9.5)*.

2.3 Model tests

2.3.1 Tests on models which satisfactorily simulate the behaviour of the platform or parts thereof, carried out by recognised laboratories, may be used as an alternative to or together with theoretical calculations.

Such model tests may be required by Tasneef as a basis for approval of structural details for which adequate analytical models are not available.

2.4 Monitoring

2.4.1 Structural monitoring

A monitoring system is recommended to be mounted on the platform's substructure in order to gain significant information regarding the actual structural response of the jacket, which significantly improve the structural reliability being capable of providing continuous data relevant to the dynamic response of the structure (by e.g. appropriate number and location of accelerometers on the jacket structural members).

Such monitoring system would be useful to provide either an active control relevant to any occurred significant variation in mass or stiffness of the structure or, through adequate filtering evaluation, updated measures of the platform's natural frequency, which, in turn, is the basis for any further fatigue evaluation required for reassessment or extension life task.

2.4.2 Meteo data measurement system

In addition to the structural monitoring system, a measurement system is also recommended to be installed on the platform since the early phases of its operating life, capable to record meteorological and marine data, such as:

- Directional wave motion;
- Current velocity and direction;
- Sea level variation:
- Wind velocity and direction;
- Air temperature,

made by, e.g.:

- Wave meter, based e.g. on the measurement of water column pressure;
- Sensors for measurement of wind velocity (anemometer) and direction;
- Current meter, to record the 2-components current velocity;
- Sensors for acquisition of meteorological data,

suitable for a following revision of statistics of wave, wind and current data with actual characterization of the meteomarine loads acting on the platform.

All the above is recommended to facilitate the reassessment process in case of, e.g., extension of the platform service life (see Part B, Chapter 6, [2.4.3] and [2.5.2]).

3 Design

3.1 General

Ref. ISO 19902:2007, Subclauses 7.5 to 7.12.

3.1.1 Platforms are to be designed so as to minimise their sensitivity to environmental factors and service loads, and to facilitate their construction and inspection.

3.1.2 The design of the platform as a whole and of its components is to be such that normal operational and habitable conditions are not impaired by structure vibrations.

3.1.3 Structures (if any) which are subject to forces from mooring lines of auxiliary or towing units are to be designed to withstand the breaking load of such lines.

3.1.4 Due consideration is to be given to corrosion and adequate protection systems against corrosion that are to be carefully examined in relation to the environmental parameters.

3.1.5 Secondary structures such as fenders, gangway ladders, mooring rings, etc. are to be designed so that possible failure due to accidental overload will not result in damage to the main structure of the platform or injury to personnel.

3.1.6 Structural connections and joints are to be designed, as far as practicable, to avoid complex structures and sharp section variations which may give rise to dangerous stress concentrations.

Transmission of primary tensile stresses through the thickness of plates is also to be avoided as far as practicable. Where this is not practicable, the use of plates with through thickness properties is generally recommended.

3.1.7 Platforms constructed to be operated in locations where low temperatures may occur are to be designed to avoid configurations which may give cause to ice accumulation on structures and machinery and are to be provided with suitable means to prevent freezing of potable water, fire-fighting water, etc.

Possible impacts of floating blocks of ice against the structures of the platform located in the splash zone are also to be considered.

3.1.8 The relevant requirements of the Tasneef Rules for ships apply to secondary structures of typical naval design (tanks, deckhouses, etc.) which do not participate in the global strength of the platform and are subject to local loads only.

3.2 Protection against accidental damage

Ref. ISO 19902:2007, Clause 10.

3.2.1 In order to protect the platform against accidental damage, the following two principles are to be considered:

a) reduction in damage probability;

b) reduction in damage consequences.

3.2.2 The structural configuration of the platform is to be designed taking account of the possibility of accidental damage.

3.2.3 Piping systems and equipment whose failure may give rise to risk for persons and/or structures are to be installed in sheltered locations or to be locally strengthened so as to minimise the risk of accidental damage.

Risers and similar equipment are to be located at a safe distance from boat berthing areas and from areas within crane outer-arm range.

3.2.4 Compartments crossed by pressure piping are to be designed to withstand the overpressure due to piping failure, unless adequate means are provided to release accidental overpressure.

3.3 Deck elevation over the waves (vs topside structures)

3.3.1 The vertical distance between the lowest part of the deck (or of the lowest of the decks) of the platform and the wave crest elevation is to be in compliance with the requirements of Part B, Chapter 4, [11.2].

As a general guidance, such distance should be not less than 0,5 m + H/30, where H is the maximum design wave height. Where H exceeds 30 m, the deck elevation may be taken equal to 1,5 m.

Smaller distances may be allowed exceptionally, provided the capability of the structure involved to withstand wave impact forces is demonstrated as well as operability and safety of possibly present equipment is not affected.

3.3.2 For determination of deck elevation the following is to be considered:

a) water depth;

b) tolerances in water depth measurements;

c) astronomical, wind and storm tide ranges;

d) maximum design crest elevation;

e) hydrodynamic interactions between platform and environment;

f) initial penetration of structure in the sea bed;

g) elastic and long-term settlement of platform;

h) platform inclination;

i) lowering of seafloor due to performance of the design service and to reservoir drainage during production.

3.4 Accessibility for inspection

3.4.1 The platform is to be designed to minimise the number of structural members which are not accessible for inspection and repair.

For structural members which are not accessible for inspection, Tasneef may specify additional more stringent requirements concerning their strength and the maintenance of their original functional characteristics.

4 Reassessment of existing platform

4.1 Assessment initiators

4.1.1 An assessment of an existing platform is to be undertaken with relevant certification if any of the following initiators are triggered:

- Changes from original design basis or from previously certified assessment basis; this changes may include, but not limited to, the aspects described in ISO 19902:2007, Subclause 24.4.a);
- Damage or deterioration of the primary structure, as outlined in ISO 19902:2007, Subclause 24.4.b);
- Design service life exceedance, with particular attention paid to time-dependant degradation phenomena (i.e. fatigue and/or corrosion).

4.2 Assessment process

4.2.1 When an initiator is triggered, the reassessment process of the structure of an offshore platform is to be carried out according to the requirements of Part B, Chapter 6 of these Rules.

5 Structure reuse

5.1 General

5.1.1 Structures that are to be removed or reused in a new location different than the original design site are to comply with the requirements of ISO 19902:2007, Clause 25, which is covering:

- Fatigue assessment for reused structures (Subclause 25.2);
- Steel properties requirements in reused structures (Subclause 25.3);

- Inspection requirements for reuse and removal (Subclause 25.4);
- Removal and reinstallation requirements (Subclause 25.5);
-
- Inspection and structural integrity management plan at new location (Subclause 25.6).

PART B CHAPTER 2

ENVIRONMENTAL CONDITIONS

1 General

1.1 Environmental phenomena

1.1.1 In order to design a platform, all environmental phenomena which may produce loads acting on the structure are to be considered. Such phenomena include: wind, waves, currents, tides, temperature, ice, marine fouling and earthquakes.

For the determination and use of metocean conditions to be adopted for design, installation and operation of offshore structures general reference can be made to ISO 19901-1:2005, Metocean design and operating considerations.

1.1.2 For the sea bed and soil layers underneath, see Part B, Chapter 5 of these Rules.

1.1.3 The salinity and biological activity of the water are to be considered in the evaluation of marine fouling increase and in the choice of the protection system against corrosion.

1.2 Acceptability of the parameters defining the design environmental conditions

1.2.1 The parameters defining the design environmental conditions for which the platform is to be approved are to be based, where possible, on significant statistical information regarding the geographical areas where the platform is to be constructed, transported and installed; such statistics are to cover a sufficiently long period of time and to be supplied by recognised meteorological-oceanographic institutes.

1.2.2 When the above-mentioned environmental parameters are based on extrapolated data or on forecasting methodologies other than those commonly used, sufficient theoretical information is to be supplied to Tasneef in order to demonstrate their reliability.

1.3 Determining parameters relevant to the design environmental conditions

(ref. ISO 19901-1:2005, Subclause 5.1)

1.3.1 The environmental phenomena are to be described by those characteristic parameters which are most significant for the evaluation of the effects of the environment on the structures.

Such parameters shall provide characterization of (ref. ISO 19901-1:2005, Subclause 5.1):

- Extreme values of environmental parameters corresponding to return periods appropriately longer than the time of exposure of the platform, or main component thereof, in a given design situation;
- Operating environmental conditions which occur frequently during the service life of the platform;
- Long term statistical distributions of metocean parameters affecting the structural response to time dependant limit state such as the fatigue limit state.

1.3.2 When the available data are conflicting, the parameters defining design environmental conditions will be those which produce the most severe effects on the structures.

1.4 Monitoring parameters relevant to the design environmental conditions

1.4.1 The monitoring of actual environmental phenomena occurring during the service life of the platform, by the installation of appropriate record devices such as wave meters, anemometers, etc., is recommended in order to collect data capable to validate the design assumptions as well as records to be used for any possible structural reassessment or extension of the platform service life.

1.4.2 The monitoring system should be installed on the platform since the early phases of its service and should be able to continuously provide record data relevant to:

- Directional wave motion;
- Current velocity and direction;
- Sea level variation;
- Wind velocity and direction;
- Air temperature,

so that they do represent actual samples to be statistically elaborated in order to provide required validation and/or updating of applicable design environmental parameters.

2 Parameters relevant to environmental phenomena

2.1 Water depth including tidal variations

(ref. ISO 19901-1:2005, Clause 6)

2.1.1 The water depth at the final installation site of the platform shall be defined including variations due to tides and storm surge.

For the definition of the different levels of water depth to be considered in both design of the structure and operability of appurtenances such as boat landing, bumpers, etc., reference can be made to Fig. 1 of ISO 19901-1:2005.

2.1.2 The following three tide components are to be considered:

a) astronomical tide;

b) barometric tide;

c) wind tide.

2.1.3 Data relevant to the three tide components are to be supplied by recognised meteorological-oceanographic institutes.

2.1.4 In consideration of difficulty in the evaluation of tide components, where data directly applicable to the final location of the platform are not available, data extrapolated from those for nearby locations may be accepted.

2.2 Wind

(ref. ISO 19901-1:2005, Clause 7)

2.2.1 The parameters describing the wind conditions are to be obtained, where possible, on the basis of wind velocity statistical data (intensity and direction).

2.2.2 Wind velocities shall be characterized as either sustained wind velocities or gust wind velocities.

2.2.3 Extreme values of gust and sustained wind velocities are to be expressed in terms of most probable maximum values with their corresponding recurrence periods.

2.2.4 The wind velocity at a height of 10 m above the mean still water level is to be used as a reference value both for sustained and gust wind speeds.

2.2.5 Global action due to wind on the platform shall be determined by using a time-averaged wind speed in the form of a sustained wind speed, whereas local actions on individual components shall be determined by using a gust wind speed.

To select appropriate averaging times reference can be made to Subclause A.7.2 of ISO 19901-1:2005.

2.2.6 When data regarding the wind velocity versus height above the still water level are not available, formulae which are given in Subclause A.7.3 of ISO 19901-1:2005 may be used.

2.3 Sea waves

(ref. ISO 19901-1:2005, Clause 8)

2.3.1 General

Sea waves may be defined by means of design deterministic waves having appropriate shapes, heights and periods when the deterministic analysis is used, or by means of power spectral density functions when the statistical analysis is used.

In both the above-mentioned cases, the parameters describing the design waves are to realistically represent the most unfavourable load conditions anticipated for the platform and are to be based upon reliable wave statistics relevant to the geographical areas considered for the various phases of the design life of the platform. Such parameters are to be deemed acceptable by Tasneef.

The evaluation of the probability distribution of the waves that the platform will meet during its life is to be carefully considered to take account of possible fatigue effects on structural members.

2.3.2 Deterministic description of the waves

When the deterministic method of sea description is used, the design waves are defined by means of the following parameters:

H : wave height, i.e. the distance measured vertically between the crest and the trough of the wave, in m;

T : wave period, in s;

L : wave length, in m;

D : mean sea depth, in m.

Where necessary, the shallow water effects are to be taken into consideration.

The analysis of the loads induced by waves on the platform is to be carried out for a few wave periods in order to ensure a sufficiently accurate determination of the maximum loads.

Normally it is sufficient to investigate the following range of wave periods:

$$8,0\sqrt{\frac{H}{g}} \le T \le 20$$

where g is the gravity acceleration, in m/s^2.

In order to define the design wave height, the smaller of the following heights is to be selected:

a) the 100 years wave height for the geographical areas concerned;

b) the breaking wave height defined according to the wave periods and the water depth as shown in the diagram in Figure 2.1.

2.3.3 Stochastic description of the waves

When the stochastic method of sea description is used, the waves are analysed taking into account stationary irregular sea states described by the spectral power density function.

The analytical expressions of the spectral power density function of the sea states are to reflect the shape and the width of the spectra of the typical sea states of the geographical areas considered.

The spectral power density function in Bretschneider's analytic formulation is generally applied for open deep-water sea areas.

A several parameter spectrum, e.g. the Jonswap spectrum, is generally to be used for shallow waters.

According to the dynamic analysis method, the long-term sea behaviour is mathematically described by means of the occurrence probability of each short-term spectrum, i.e. by means of a distribution function of sea states.

Generally the distribution function is used in biparametrical form (e.g. significant wave height $H_{1/3}$ and average zero up-crossing period T), which may be obtained from wave statistics relevant to the geographical areas considered.

2.3.4 Mean still water level

The mean still water level to be used in wave load calculations is defined as the level which produces the most unfavourable effects in the range between the highest astronomical tide level, increased by the wind and pressure induced effects, and the lowest astronomical tide level.

2.4 Currents

(ref. ISO 19901-1:2005, Clause 9)

2.4.1 The current velocity data (intensity, direction and variation depending on the distance above the sea bottom) relevant to the geographical areas considered are to be deduced from reliable statistics.

2.4.2 In order to calculate the design current velocity, all the main current components are to be taken into account in the vector sum; the main current components are generally the following:

a) tide component;

b) residual component;

At many locations the largest component of the residual current to be considered is the wind driven current.

2.4.3 When reliable data relevant to current velocity variations versus the distance from the sea bottom are not available, the following formulae may be used:

$$v_m(z) = v_m(d) \cdot \left(\frac{z}{d}\right)^{\frac{1}{7}}$$

$$v_v(z) = v_v(d) \cdot \left(\frac{z}{d}\right)$$

where:

$v_m(z), v_v(z) =$ tidal current velocity and wind generated current velocity at a distance z above the sea bottom, in m/s;

$v_m(d), v_v(d) =$ tidal current velocity and wind generated current velocity at the still water surface, in m/s;

z : distance from the sea bottom to the point where the current velocity is to be calculated, in m;

d : distance from the sea bottom to the still water surface, in m.

2.4.4 The current velocity of the wave fluid particles above the mean still water level is to be assumed equal to the velocity at the mean still water level.

In order to evaluate the current profile modification due to the presence of waves (current profile stretching), reference can be made to Subclause A.9.4 of ISO 19901-1:2005.

2.4.5 In open sea areas the current velocity may be calculated by the following formula:

$$v_v(d) = 0,01 v_{10,c}$$

where $v_{10,c}$ is the sustained wind velocity, in m/s, measured at a height of 10 m above the still water level.

2.4.6 In locations where the sea floor is subject to erosion, special studies on currents in proximity of the sea bottom may be required.

2.4.7 The actual space frame density (or ‘transparency’ to the hydrodynamic loading) of the platform’s substructure will reduce the current velocity as evaluated for a free field. This may be taken into account, particularly for jacket accommodating a large number of risers or conductors, by the evaluation of an appropriate current blockage factor (ref. ISO 19901-1:2005, Subclause 9.5).

2.5 Temperature

2.5.1 Extreme values of temperature are to be expressed in terms of the most probable highest and lowest values and their corresponding recurrence periods.

2.5.2 Both air and sea temperature are to be considered.

2.5.3 The design temperature for the various components of the platform is to be assumed equal to the lowest daily average air temperature or sea temperature, depending on the position of the single components, for the geographical areas concerned.

The lowest daily average temperature is defined as the lowest of the daily average temperature values continuously recorded over a sufficient number of years (at least 10), at a height of 10 m above sea level for air temperature and 1 m below sea level for sea temperature.

2.6 Sea ice, ice accretion and snow

(ref. ISO 19901-1:2005, Subclauses 10.4 and 10.5)

2.6.1 In the case of platforms to be located in sea areas where ice may develop or drift ice may be present, this environmental condition is to be considered.

2.6.2 In order to describe the environmental condition mentioned in [2.6.1], particular consideration is to be given to the following data:

a) ice concentration and distribution;
b) type of ice (ice floes, ice ridges, rafted ice, etc.);
c) mechanical properties of ice;
d) ice drifting speed;
e) ice thickness;
f) probability of encountering icebergs.

2.6.3 The possibility of ice formation on the platform is to be duly considered with particular attention to ice concentration, distribution and thickness, particularly where icing increase the diameter of structural members leading to substantial increase of vertical and horizontal actions.

2.6.4 When relevant, snow accumulation on topsides shall be taken into account in the design of the structure.

2.7 Marine fouling

(ref. ISO 19901-1:2005, Subclause 10.1)

2.7.1 Marine fouling on the underwater structures and on the splash zone is to be duly evaluated on the basis of biological and environmental factors, relevant to the water in the site considered, such as:

a) salinity;
b) oxygen content;
c) pH value;
d) current;
e) temperature.

2.8 Earthquakes

2.8.1 The effects of earthquakes are to be considered when platforms are installed in seismically active geographical areas.

An area is defined as seismically active on the basis of its previous seismic history expressed in terms of frequency of occurrence and magnitude of earthquakes.

For the purpose of platform design, the seismic activity of an area may be expressed in terms of effective ground acceleration associated with a response spectrum or by means of a time history of the ground accelerations of the earthquake assumed for the design.

The most widely used input parameter for the seismic verification of fixed offshore platforms is the design response spectrum, i.e. the spectral response associated to given level of peak ground acceleration (PGA), which shall be obtained from a site-specific seismic hazard assessment.

The site-specific seismic hazard assessment will provide the response spectrum computed from a probabilistic seismic hazard analysis (PSHA) by taking into account local soil conditions.

In general, the site-specific seismic hazard assessment can be carried out according to the provisions of Clause 8 of ISO 19901-2:2005, Seismic Design Procedures and Criteria.

2.8.2 The analysis of seismic characteristics of the location is to include an evaluation of:

a) characteristics of the ground motions anticipated for the design life of the platform;
b) allowable seismic risk in relation to the design operation;
c) ground instability due to liquefaction;
d) instability of the sea floor;
e) proximity to faults.

In general, other geologically induced hazards other than earthquake-induced ground motions, such as liquefaction, slope instability, faults, tsunamis, mud volcanoes and shock waves are mentioned and briefly discussed in ISO 19901-2. When significant, they must be taken into account during the design and they shall be addressed with special studies.

2.8.3 The input parameter characterization for seismic assessment is to be made for two levels of earthquake, defined according to ISO 19901-2:2005, Subclause 6.1 as follows:

- Extreme Level Earthquake (ELE): *The structure shall be designed such that an ELE event will cause little or no damage.*

Shutdown of production operations is tolerable and the structure should be inspected subsequent to an ELE occurrence.

- Abnormal Level Earthquake (ALE): *The structure shall be designed such that overall structural integrity is maintained.*

Considerable damage can be reached but loss of life and/or major environmental damage is avoided..

2.8.4 Return periods for both ELE and ALE events can be assigned according to platform's exposure level (see Part B, Chapter 1, [1.2]) and target annual failure probabilities given in ISO 19901-2:2005, Subclause 6.4, eventually modified to meet more stringent regulator or regional requirements, if any.

2.8.5 In the case of platforms to be installed in shallow waters, the possibility of seaquake occurrence is to be considered by evaluating the actual likelihood of tsunamis affecting the location of the platform.

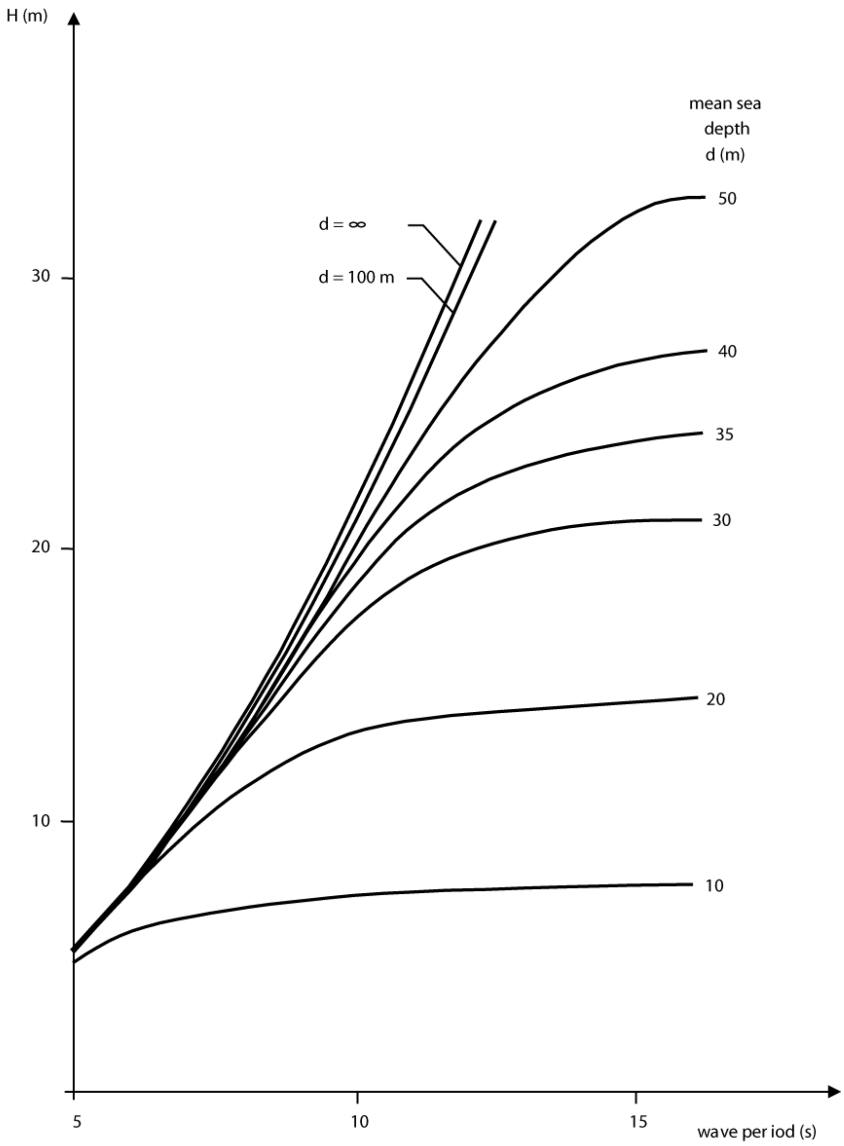


Figure 2.1 – Breaking wave height.

PART B CHAPTER 3

DESIGN LOADS

1 General

1.1 General requirements

1.1.1 In platform design, consideration is to be given to all loads which may influence the scantlings both of the platform as a whole and of its structural members.

1.1.2 Loads acting on the structure are to be determined for the different design situations occurring during all the phases of the design life, i.e.:

a) Pre-service situations:

  a. Fabrication;

  b. Assembly;

  c. Loadout;

  d. Transportation;

  e. Installation;

b) In-place;

c) Removal,

as well as rational combination thereof, to obtain the most critical design condition for all the structural components.

1.1.3 Adequate provisions are to be taken at design stage in order to make the removal of the platform feasible and safe, according to Subclause 8.8 of ISO 19902:2007.

1.1.4 In the evaluation of loads, the increase in dimensions and mass of the platform due to marine fouling, ice accumulation, etc. is to be considered, as to be included in Q_1 (see [4.3], ref. Subclause 9.2.3 of ISO 19902:2007).

2 Loads due to pre-service situations

2.1 Loads definition

2.1.1 Such loads act on the platform as a whole or on its parts due to the following operations:

a. lifting;

b. movement and handling onshore or onto floating units;

c. location on supports;

d. assembly;

e. transportation on barges;

f. towing of floating platform;

g. launching from barge;

h. upending;

i. mooring;

j. positioning in the location;

k. ballasting and submerging;

l. penetration into the sea bed, pile driving and foundation system completion;

m. installation of decks, modular components, etc.

2.1.2 Construction and installation loads are to be determined taking account of static values of forces, pressures, dynamic amplification factors, effects of working tolerances and the influence of environmental conditions.

2.1.3 For the description of the loads that are to be considered, their characterization and relevant combination, reference is to be made to Clause 8 of ISO 19902:2007. In particular, the requirements of Clause 8.2 shall apply in relation to the different actions occurring during pre-service situations, whose determination shall be carried out according to:

- Subclause 8.3 for lifting;

- Subclause 8.4 for fabrication;

- Subclause 8.5 for loadout;

- Subclause 8.6 for transportation;

- Subclause 8.7 for installation.

3 Loads for in-place situation

3.1 Loads definition

3.1.1 Design situations to be considered for the platform in place can be split into:

a. persistent situations;

b. accidental situations;

3.1.2 For the description of the different loads that are to be considered for the persistent situations, their characterization and relevant combination, reference can be made to Clause 9 of ISO 19902:2007.

3.1.3 For characterization of loads relevant to accidental situations, reference can be made to Clause 10 of ISO 19902:2007, in addition to the prescriptions of [4.4].

4 Type of loads

4.1 General

4.1.1 The loads acting on the structures, for the different design situations described above, can be grouped in:

a) permanent loads;

b) variable loads;

c) environmental loads;

d) accidental loads.

4.2 Permanent loads

4.2.1 Permanent loads are those due to permanent action, of type G_1 *or* G_2, respectively described at Subclauses 9.2.1 and 9.2.2 of ISO 19902:2007.

4.2.2 Permanent action G_1 is relevant to gravitational or imposed loads permanently acting on the platform, which do not change during the whole service life; they include:

a) the weight of the platform, including the weight of piles, grout and solid ballast as applicable;

b) weight of machinery and systems permanently (i.e. along the whole service life) mounted on the platform;

c) weight of foreseen water ballast, if any, as well as water entrapped in the structure due to unintentional flooding;

Note that, according to ISO 19902:2007, Subclause 9.2.5 the following checks are to be performed:

- All underwater members designed as to be watertight shall be checked for strength for the dry as well for the flooded condition;
- All members intended to be flooded shall also be checked for strength for both dry and flooded condition, unless permanent flooding is guaranteed,

d) external hydrostatic pressure and buoyancy on the watertight underwater structures.

4.2.3 Permanent action G_2 is relevant to gravitational or imposed loads acting on the platform due to the self weight of equipment or facilities that can be added or removed during the platform's service life, depending on the mode (e.g. drilling or production) of operation (i.e. they are permanent loads just for a given design phase).

4.3 Variable loads

4.3.1 Variable loads are those due to variable action, of type Q_1 *or* Q_2, respectively described at Subclauses 9.2.3 and 9.2.4 of ISO 19902:2007.

4.3.2 Variable loads Q_1 shall include (ref. ISO 19902:2007, Subclause 9.2.3):

- The weight of consumable supplies and fluids in pipes, vessels and storage tanks as well as the weight of transportable vessels and containers;
- the weight of scaffolding or other temporary access systems used during operations and maintenance of the platform;
- the weight of personnel, and personnel belongings, operating on the platform;
- the weight of marine fouling and ice, where appropriate.

4.3.3 The characteristic value of Q_1 is to be evaluated, for given mode of operation, on the basis of the Designer's specifications, in terms of heaviest material and largest personnel capacity for given destination areas on the platform topside.

In any case, variable loads acting on decks should not be assumed less than:

a) crew spaces, accommodation spaces, walkway areas: 4,5 kN/m^2;

b) working areas: 9,0 kN/m^2;

c) storage areas: 13,0 kN/m^2.

4.3.4 Variable loads Q_2 are functional loads acting on the main structure due to short term operations, such as (ref. ISO 19902:2007, Subclause 9.2.4) lifting of drill string, lifting by crane and lifting appliances, machine operations, vessel mooring and helicopters.

4.3.5 Still according to ISO 19902:2007, additional weight due to liquids used for testing of pressure vessels are to be included in Q_2.

Maximum and minimum value of the permanent load G_2, as well as those of the variable loads Q_1 and Q_2 shall be considered for the determination of the most critical condition for each structural component.

4.3.6 Maximum allowable values of functional loads and of the combination of such loads for any area or structural component of the platform are to be specified in the Operating Manual.

4.3.7 Loads due to mooring of supply units are to be kept below the design value by the use of devices providing release of mooring lines in case of accidental overloads.

4.4 Environmental loads

4.4.1 All the forces induced on the platform by the environmental factors specified in Part B, Chapter 2 are defined as environmental loads.

4.4.2 In order to design the platform structures, the statistical environmental conditions are to be split into two reference conditions:

a) operating environmental conditions: the environmental conditions within which the normal design service is performed. The recurrence period of such limiting condition is to be specified by the designer, approved by Tasneef and recorded in the operating manual of the platform, if applicable, in terms of owner-defined operating wind, wave and current parameters. The typical recurrence period generally assumed for operating conditions in in-place design situation is 1 year;

b) extreme environmental conditions: environmental conditions defined by a recurrence period appropriately longer than the time of exposure of the platform, or main component thereof, in a given design situation (e.g. 100 years for in-place situation).

4.4.3 Environmental loads due to operating and extreme environmental conditions may be reported as operating and extreme environmental loads respectively, and they generally vary in time, being mainly governed by waves, thus inducing some degree of dynamic amplification on the structure.

4.4.4 For fixed offshore platforms whose natural frequency corresponding period is adequately low, the dynamic amplification of the global structure response is negligible. The environmental loads can then be represented as quasi-static actions, and the operating and extreme quasi-static load due to wind, waves and current are indicated as E_o and E_e, according to the ISO 19902:2007 notation, respectively.

4.4.5 When dynamic effects need to be taken into account but remain limited in magnitude, the dynamic amplification of the global structural response can be adequately represented by an additional equivalent quasi-static action representing the dynamic response, defined as D_o or D_e, according to ISO 19902:2007 notation, if caused by the wave condition that corresponds with that for E_o and E_e respectively.

4.4.6 For short-term operations or phases, the characteristic values of loads are to be based on reliable meteorological forecasts.

In such cases the values of loads to be considered and the allowable environmental conditions to start the operations are to be approved by Tasneef.

For construction, transportation, installation and removal phases the recurrence period is to be determined depending on the geographical area, the season and the influence of environmental factors on the safety of the operations.

The environmental conditions to be considered for the structural and stability checks to be performed for the installation phase are to be appropriately defined in relation to the time expected to cover all stages of installation (including the stage when the platform is upright and placed on the sea floor but not yet permanently anchored) and consistent with the limiting environmental conditions reported in the installation procedure (ref. ISO 19902:2007 Subclause 8.7.6.1).

For structures that are to be piled the design shall ensure that the requirements of ISO 19902:2007 Subclause 8.7.6.1 points from a) to c) are satisfied.

4.4.7 The simultaneous occurrence of various environmental loads is to be carefully considered in the design of the platform.

In general, seismic loads need not be considered as acting simultaneously with other environmental loads.

4.5 Accidental loads

4.5.1 Loads whose intensity and recurrence period are difficult to define belong to the group of accidental loads.

These loads are those associated to accidental situations, as introduced by ISO 19902:2007, Clause 10, due to hazards having widely different probability of occurrence or return period.

4.5.2 According to ISO 19902:2007, hazards can be categorized in 3 groups:

- Group 1: hazards with a yearly probability of being exceeded of the order of 10^{-2} (return periods of the order of 100 years);
- Group 2: hazards with a yearly probability of being exceeded of the order of 10^{-3} to 10^{-4} (return periods of the order of 1000 to 10000 years):

- Group 3: hazards with a yearly probability of being exceeded significantly lower than 10^{-4} (return periods far in excess of 10000 years).

Hazards belonging to Group 1 and not treated by the regular design process (such as those from exposure to design environmental conditions: wind, waves, current and earthquakes), as well as hazards belonging to Group 2 (such as those associated to abnormal environmental actions) are addressed by verification of relevant accidental limit states (ALS) to be assessed through specified accidental situations (ref. ISO 19902:2007 Subclauses 10.1.3 to 10.1.6).

Hazards belonging to Group 3 may normally be not considered for design.

4.5.3 For the hazard to be considered, besides relevant accidental loads to be assessed, the platform structure shall be also verified after the hazardous event situation, where the structure has to be checked in relation to specified environmental actions, in case that the structure capability has been reduced by damage caused by the hazard.

4.5.4 After damage design situation are to be evaluated according to ISO 19902:2007, Subclause 10.1.6, while for the possible accidental situations involving the hazard considered, the designer can choose between implementing relevant protective measures or design for the accidental loads inherent the hazard.

In particular, the typical accidental loads considered for offshore platform's structural design are those due to:

- Ship collision;
- Dropped objects impact;
- Fire and Explosion.

If the design option is chosen, relevant accidental situations shall be assessed according to ISO 19902:2007, Subclauses 10.2, 10.3 and 10.4 for the 3 types of hazards respectively, and design requirements shall be established taking account of the operational conditions of the platform.

5 Determination of environmental loads

5.1 Extreme environmental action due to wind, wave and current

5.1.1 As described in [4.4.4], the environmental actions due to the wind, wave and current loads combination can be treated as quasi-static action if the dynamic amplification of the global structural response is negligible (see also ISO 19902:2007, Subclause 9.3.1).

The determination of the extreme quasi-static action due to wind, waves and current, E_e can be carried out according to the procedures outlined in ISO 19902:2007, Subclause 9.4.1.

Being environmental loading acting on fixed offshore platforms normally dominated by waves, E_e can be estimated by 100 year return period wave height (significant or individual) with associated wave period, wind and current velocities.

5.1.2 When dynamic effects need to be taken into account but remain limited in magnitude, as discussed in [4.4.5], the determination of the extreme quasi-static action representing the dynamic response, D_e can be carried out according to the methods outlined in ISO 19902:2007, Subclause 9.8.2, provided that both the requirements a) and b) reported in Subclause 9.8.1 of ISO 19902:2007 are satisfied.

In that case, a global dynamic analysis is to be carried out according to the requirements of ISO 19902:2007, Subclause 9.8.3, for the determination of the extreme dynamic base shear required for the evaluation of D_e.

5.1.3 If the dynamic effects exceed the limitations given in ISO 19902:2007, Subclause 9.8.1, a detailed dynamic analysis shall be performed according to requirements reported in ISO 19902:2007, Clause 12.

5.2 Global action

5.2.1 Global base shear and overturning moment acting on the platform structure are calculated as vectorial sum of hydrodynamic loads due to waves and current integrated over the submerged structure, including possible dynamic amplification factor, and wind loads on the emerged structure due to wind.

In order to determine maximum values of global base shear and/or overturning moment, an appropriate selection of both the wave crest position (with respect to the structural section geometry) and the water depth shall be made by taking into account the recommendations reported at Subclause 9.4.3 of ISO 19902:2007.

5.3 Wave and current induced loads

5.3.1 Wave induced loads are to be determined by means of recognised techniques taking account of sea depth and of the shape, dimensions and type of the platform.

5.3.2 Hydrodynamic coefficients used for the analytical determination of wave loads may be taken from available published data or model tests. Typical values of drag and inertia coefficients to be used in Morison's equation (see [5.3.5]) are reported in Subclause 9.5.2.3 of ISO 19902:2007. Values of these coefficients are, in any case, subject to approval by Tasneef.

5.3.3 When, in the case of structures of complex shape, the analytical determination does not ensure sufficient reliability, the results of reliable model tests are to be used.

5.3.4 In the determination of wave loads the following components are to be considered:

a) forces due to wave velocity potential, which consists of the incident potential, the diffraction potential and, when applicable, the radiation potential;

b) wave drift forces;

c) drag forces due to the effects of boundary layer and vortex shedding;

d) slamming loads.

5.3.5 Wave induced loads on slender structural members with cross-sectional dimensions less than approximately 1/5 of the wave length may be calculated using Morison's equation (see Subclause 9.5.2.1 of ISO 19902:2007) including marine growth effect (see also Subclause 9.5.2.2 of ISO 19902:2007).

When large volume structures are present, the forces due to wave velocity potential (see [5.3.4] a)) acting on such structures are to be determined by calculation of velocity potential using congruent theories such as the sink-source technique or the finite fluid element method.

5.3.6 The simultaneous effects of inertia forces and drag forces are to be vectorially added taking account, when applicable, of possible changes in water particle velocity and acceleration due to the presence of the platform.

5.3.7 When the cross-sectional dimensions of structural members are comparable with member spacing, the effects of hydrodynamic interaction are to be considered.

5.3.8 Impact loads from waves on the structures are to be determined according to recognised theoretical methods or from results of model tests. Possible dynamic amplification of such loads is to be carefully considered.

5.3.9 The possibility of vortex induced cyclic loads is to be considered.

5.3.10 Current induced loads on structural members consist of drag forces to which the same considerations for wave loads apply.

5.3.11 When acting simultaneously, the combined effects of current and waves may be evaluated within the field of application of Morison's equation, by adding vectorially the current velocity to the water particle velocity due to waves, in order to calculate the local action due to waves plus current.

5.3.12 The total quasi static action due to waves and current can be calculated according to the procedure given in Subclause 9.5.1 of ISO 19902:2007.

5.3.13 The possibility of vortex induced cyclic loads is to be considered according to Subclause 9.4.5 of ISO 19902:2007.

5.3.14 Appurtenances (e.g. boat landings, fenders, bumpers, anodes, etc.) shall be included in the hydrodynamic model of the platform e.g. by means of non-structural members providing equivalent hydrodynamic loads according to Subclause 9.5.3 of ISO 19902:2007.

5.3.15 Current blockage factor and conductor shielding factor shall be considered, if applicable, in global hydrodynamic loading evaluation, as specified by ISO 19902:2007 in Subclauses 9.5.2.4 and 9.5.2.5 respectively.

5.4 Wind loads

5.4.1 The effect of wind on the above water parts of the platform induces pressures and forces which are to be evaluated considering both sustained and gust velocities of the wind taken for design.

5.4.2 Theories, coefficients and calculations used for the evaluations of pressures and forces induced by wind are to be deemed acceptable by Tasneef. In order to determine actions caused by wind considerations shall be given to what reported by ISO 19902:2007, Subclause 9.7.

5.4.3 As an alternative to the above calculations, the results of consistent model tests carried out by recognised technological laboratories may be accepted.

5.4.4 Wind loads calculated on the basis of the 1 minute sustained wind velocity are to be used in combination with maximum wave loads.

When wind loads due to 3 seconds gust wind velocity are higher than those due to sustained wind loads combined with wave loads, loads due to gust wind are to be considered.

5.4.5 For slender cylindrical members, in addition to the static wind loads, cyclic wind loads due to vortex shedding are to be considered.

5.4.6 Dynamic effects of gust wind are to be considered, as well as possible increase of wind velocity due to wind flow through closely spaced members.

5.5 Ice loads

5.5.1 Ice loads are to be determined on the basis of statistics relevant to the geographical areas considered. Lateral ice loads on the platform are to be based on relevant full scale measurements or on reliable model tests or on recognised theoretical calculation methods. The thickness, direction of movement, mechanical properties and nature of ice and the shape of the structure surfaces of the platform which may come in contact with ice are, in any case, to be considered.

Other types of ice loads include:

a) static loads due to ice accumulation on superstructures and decks;

b) impact loads due to impact of ice dropping during thaw;

c) forces acting on the structures subject to wind and wave actions due to increase of exposed areas caused by ice accumulation;

d) impact loads due to impact of ice floes against the platform.

5.5.2 The impact loads due to ice floes are to be based on full scale measurements or on model tests or on recognised theoretical calculation methods taking account of the nature of ice and its mechanical properties, of the shape of platform structures which may be subject to ice impact and of the direction of ice movement.

5.6 Seismic loads

5.6.1 General

The effects of earthquakes are to be considered in the operation phase of platforms which are located in seismically active geographical areas. Seismic loads may be required to be considered during the construction phase only in special cases.

In any case, for the definition of seismic loads for a given offshore platform site, priority shall be given to mandatory compliance with Government Regulations (see also the provisions of Part A, Chapter 1, [2.2]).

5.6.2 Seismic action determination

Procedures for determining seismic actions and different methods to be used for the evaluation of the site specific seismic activity are identified by ISO 19901-2:2004.

Appropriate procedure and method of evaluation of the seismic activity depend on the structure seismic risk category (SRC), which is defined in Subclause 6.4 of ISO 19901-2:2004 as a function of both the exposure level of the platform and the seismic zone in which it stands.

Seismic zone can be determined by using Table 3.1 (ref. ISO 19901-2:2004, Subclause 6.4) as a function of the value of the 1,0s horizontal spectral acceleration, which can be obtained from the worldwide seismic maps reported in Annex B of ISO 19901-2:2004.

$S_{a,map}(1,0)$	< 0,03 g	0,03 g to 0,10 g	0,11 g to 0,25 g	0,26 g to 0,45 g	> 0,45 g
Seismic Zone	0	1	2	3	4

Table 3.1 - Site seismic zones.

The following Table 3.2, corresponding to Table 3 of ISO 19901-2:2004 is therefore reported for the purpose:

Site Seismic Zone	Exposure Level (see Part B, Chapter 1, [1.2])		
	L3	L2	L1
0	SRC 1	SRC 1	SRC 1
1	SRC 2	SRC 2	SRC 3
2	SRC 2	SRC 2	SRC 4

3	SRC 2	SRC 3	SRC 4
4	SRC 3	SRC 4	SRC 4

Table 3.2 - Seismic risk categories.

If the design lateral seismic action is smaller than 5% of the total vertical action comprising the sum of permanent actions plus variable actions minus buoyancy actions, SRC 4 and SRC 3 structures may be re-categorized as SRC 2.

According to the SRC classification, different seismic design requirements shall apply as given in Table 4 of ISO 19901-2:2004. According to that, either simplified (ref. ISO:19901-2:2004, Clause 7) or detailed procedure (ref. ISO:19901-2:2004, Clause 8) to determine seismic action can be used.

Likewise, the seismic activity and the associated response spectra for the design of the platform shall be evaluated by different methods:

- ISO maps,
- Regional maps, or
- Site-specific seismic hazard analysis,

depending on the platform's SRC too.

The mentioned criteria, in compliance with ISO 19901-2:2004, are reported in Table 3.3 for the sake of clarity:

SRC	Seismic action procedure	Evaluation of seismic activity
1	None	None
2	Simplified (ref. ISO 19901-2:2004, Clause 7)	ISO maps or regional maps
3*	Simplified (ref. ISO 19901-2:2004, Clause 7)	Site-specific, ISO maps or regional maps
	Detailed (ref. ISO 19901-2:2004, Clause 8)	Site-specific
4	Detailed (ref. ISO 19901-2:2004, Clause 8)	Site-specific

Table 3.3 - Seismic action determination criteria

* For an SRC 3 structure, a simplified seismic action procedure is in most cases more conservative than a detailed seismic action procedure. For evaluation of seismic activity, results from a site-specific probabilistic seismic hazard analysis (PSHA) are preferred and should be used, if possible. Otherwise regional or ISO seismic maps may be used. A detailed seismic action procedure requires results from a PSHA whereas a simplified seismic action procedure may be used in conjunction with either PSHA results or seismic maps (regional or ISO maps).

PART B CHAPTER 4

STRUCTURAL ANALYSIS

1 Design loading conditions

1.1 General

1.1.1 Stresses on primary structures of platform are to be evaluated assuming the design loads specified in Chapter 3 in their most unfavourable combination which may be reasonably anticipated.

1.1.2 Appropriate design loads combinations for the different design situations shall be represented by multiplying each representative action by a partial action factor so that the design load(s) for a given design situation comprise one or more combinations of factored actions.

1.1.3 Platform structural components are to be verified using adequate methods, recognised and accepted by Tasneef.

Specifically, for a quasi-statically responding structure, the design satisfying the ultimate limit states can be carried out by the partial design format described in Subclause 9.10.3 of ISO 19902:2007.

Accordingly, each structural component of the platform shall be strength checked by using the internal force due to the combination of factored:

a) Permanent loads (described in Chapter 3, [4.2]);

b) Variable loads (described in Chapter 3, [4.3]);

c) Environmental loads (described in Chapter 3, [4.4]).

1.2 Design loading condition for in-place situations

1.2.1 According to the ISO 19902:2007 nomenclature, the design action F_d representing the loading condition for in-place situation is generally expressed by the formulation reported in Subclause 9.10.3.2:

$$F_d = \gamma_{f,G1} G_1 + \gamma_{f,G2} G_2 + \gamma_{f,Q1} Q_1 + \gamma_{f,Q2} Q_2 + \gamma_{f,,Eo} (E_o + \gamma_{f,D} D_o) + \gamma_{f,Ee} (E_e + \gamma_{f,D} D_e)$$

where:

- G_1 and˜G_2 are the permanent loads defined in Chapter 3, [4.2];
- Q_1 and Q_2 are the variable loads defined in Chapter 3, [4.3];
- E_o and E_e are the operating and extreme quasi-static environmental loads defined in Chapter 3, [4.4.4];
- D_o and D_e are the equivalent quasi-static loads representing the dynamic response, caused by the operating and extreme wave condition respectively, as defined in Chapter 3, [4.4.5].
- $\gamma_{f,i}$ are the partial load factors to be applied for the different design conditions for in-place situations with the values reported, according to Table 9.10-1 of ISO 19902:2007, in Table 4.1 (where N/A means that the corresponding load is not applicable in relevant design condition).

Design condition	**Partial load factor**					
	$\gamma_{\phi,\Gamma 1}$	$\gamma_{\phi,\Gamma 2}$	$\gamma_{\phi,\Theta 1}$	$\gamma_{\phi,\Theta 2}$	$\gamma_{\phi,E o}$	$\gamma_{\phi,E \varepsilon}$
Gravitational loads only	1,3	1,3	1,5	1,5	N/A	N/A
Operating environmental condition (in this case G_2 Q_1 and Q_2 shall be the maximum values for each mode of operation)	1,3	1,3	1,5	1,5	0,9 $\gamma_{f,E}$	N/A
Extreme environmental condition, when the effect of permanent and variable loads are additive (in this case G_1 G_2 and Q_1 shall include those parts of each mode of operation that can reasonably be present during extreme conditions)	1,1	1,1	1,1	N/A	N/A	$\gamma_{f,E}$
Extreme environmental condition, when the effect of permanent and variable loads oppose (in this case G_2 and Q_1 shall exclude any parts associated with the mode of operation considered that cannot be ensured of being present during extreme conditions)	0,9	0,9	0,8	N/A	N/A	$\gamma_{f,E}$

Table 4.1 – Partial load factors for permanent and variable loads for in-place situations and exposure level L1.

1.2.2 The values of $\gamma_{f,G1}$, $\gamma_{f,G2}$, $\gamma_{f,Q1}$, $\gamma_{f,Q2}$ are independent of the specific site location of the platform, while specific values of the partial factor $\gamma_{f,,E}$ and $\gamma_{f,D}$ to be applied to the environmental loads E_i and D_i are to be determined, given the target safety level represented by the exposure level introduced in Part B, Chapter 1, [1.2], on a 'regional' basis, which means that they are defined for given geographical areas, or regions within geographical areas (ref. ISO 19902:2007, Subclause 9.9.3).

1.2.2 Various studies have been performed to determine appropriate values of ˜ $_{f,,E}$, particularly calibrated to Gulf of Mexico, North Sea or Mediterranean areas. Examples are described in Appendix A.9.9.3.3 of ISO 19902:2007 as well as further detailed regional information, where available, included in its Annex H of ISO 19902:2007.

1.2.3 Where no information on partial load factors calibrated to the site location under consideration is available, the following factors may be assumed:

$$\gamma_{f,E} = 1{,}35;$$

$$\gamma_{f,D} = 1{,}25,$$

based on calibration work done for the Gulf of Mexico for the API-LRFD standard.

As reported in ISO 19902:2007, A.9.9.3.3 and A.9.9.3.4, these factors were generally also found to be appropriate for some other areas, with the reservation expressed in its appendix A.9.9.3.2.

1.3 Design loading condition for pre-service situations

1.3.1 Both the platform structural components and any temporary component (e.g. buoyancy aids) attached to the structure for pre-service situations shall be strength checked using the internal force or action effect (S) due to the design action F_d, representing the loading condition for pre-service situation, which can be generally expressed by the formulation reported in Subclause 8.2.4.1 of ISO 19902:2007:

$$F_d = \gamma_{f,GT}\, G_T + \gamma_{f,QT}\, Q_T + \gamma_{f,,T}\, T$$

where:

- G_T is the permanent load due to the weight of the structure, either in air or in water (submerged weight), during the transient situation under consideration, including permanent equipment and ballast;
- Q_T is the variable load due to the weight of temporary equipment or other arrangement installed on the structure during the transient situation;
- T represents the action from the transient situation under consideration.

1.3.2 For the description of the loads that are to be considered, their characterization and relevant combination, reference can be made to Clause 8 of ISO 19902:2007. In particular, the requirements of Subclause 8.2 shall apply in relation to the different actions occurring during pre-service situations, whose determination shall be carried out according to:

- Subclause 8.3 for lifting;

- Subclause 8.4 for fabrication;

- Subclause 8.5 for loadout;

- Subclause 8.6 for transportation;

- Subclause 8.7 for installation.

1.3.3 In calculating internal forces in the structural components for given transient situation, the following three design conditions are to be considered, with relevant partial load factor reported according to ISO 19902:2007, Table 8.2-1:

Design condition	Partial load factor		
	$\gamma_{f,GT}$	$\gamma_{f,QT}$	$\gamma_{f,T}$
Gravitational loads are dominant	1,3	1,3	1,0
Transient action effects are dominant and the effect of permanent and variable loads are additive	1,1	1,1	$\gamma_{f,E}$
Transient action effects are dominant and the effect of permanent and variable loads oppose	0,9	0,9	$\gamma_{f,E}$

Table 4.2 – Partial load factors for transient situations.

1.3.3 Additional safety factors and requirements for lifting are reported in ISO 19902:2007, Subclause 8.3.

1.3.4 According to ISO 19902:2007, Subclause 8.2.4.2, in case that it is not appropriate to apply partial load factors, such as design situations related to transportation, lifting or launching where dynamic or non-linear effects are relevant, the safety factor $\tilde{}_{f,Sun}$ = 1.3 shall be applied to the sum of the applicable unfactored loads as follows:

$$F_d = \tilde{}_{f,Sun} (G_T + \tilde{}\ Q_T + \tilde{}\ T),$$

to determine the internal forces and check the structural components accordingly.

If both the methods outlined in [1.3.2] and [1.3.4] respectively are applicable, the one giving the more onerous result shall be adopted.

1.4 Design loading condition for removal situations

1.4.1 For the description of the loads that are to be considered, their characterization and relevant combination, reference can be made to applicable requirements of ISO 19902:2007, Subclause 8.2 with due consideration to Subclause 8.8.

1.5 Design loading condition for accidental situations

1.5.1 As described in Part B, Chapter 3, [4.5.4], if the design option is chosen to cope with accidental loads, the structural components shall meet the strength requirements by checking relevant accidental limit states (ALS), where all partial action and resistance factors are set to 1.0.

ALS verification shall ensure that that the structure can withstand specified accidental situations and, if damage occurs, that it subsequently maintains structural integrity for a sufficient period under given environmental conditions to enable complete evacuation or repairs to take place. This requirement is also called the progressive limit state (PLS) verification.

1.5.2 According to ISO 19902:2007, Subclause 10.1.3, hazards associated with abnormal environmental actions due to wind, wave and current fall into Group 2 and should be therefore verified for corresponding ALS based on a return period of 10000 years for an exposure level L1 platform (see ISO 19902:2007, Subclause 10.1.5). However, this abnormal design situation is normally less onerous than the ULS verification corresponding to extreme environmental actions (see Table 10.5-1 of ISO 19902:2007 for a comparison between the requirements for extreme and abnormal environmental actions). Consequently, this verification can be neglected apart from the provision of an appropriate air gap to avoid loss of human life, damage to the environment or unacceptable damage to property in correspondence of abnormal wave height occurrence.

1.5.3 The abnormal design situation for abnormal earthquake actions, if applicable, is to be verified based on the ALE requirements reported in [2.3].

2 Seismic design

2.1 Seismic design criteria

2.1.1 As outlined in Part B, Chapter 2, [2.8.3], two different levels of earthquakes shall be considered:

a) Extreme Level Earthquake, *ELE* according to ISO 19901-2:2004 definition, corresponding to some extent to the most probable severest earthquake expected to occur during the service period of the platform in its location;
b) Abnormal Level Earthquake, *ALE* according to ISO 19901-2:2004 definition, corresponding to the rare intense earthquake.

The platform structure shall have strength such as stresses induced by the ELE are kept within acceptable limits and sufficient ductility to ensure absorption and dissipation capacity of energy when subjected to the ALE.

In particular, ELE performance requirements that shall be verified are those listed at Subclauses 11.5 of ISO 19902:2007 and 9.1 of ISO 19901.2:2004, while ALE performance requirements are listed at Subclauses 11.6 of ISO 19902:2007 and 9.2 of ISO 19901.2:2004.

2.1.2 According to Table 11.2-1 of ISO 19902:2007 (reported in the following Table 4.3), except for platforms pertaining to SRC 1, a platform structural **ductile design** is recommended and can be provided following to the provisions of ISO 19902:2007, Subclause 11.4.

SRC	Recommendations for ductile design
1	Not applicable
2	Optional
3	Recommended
4	Recommended

Table 4.3 – Applicability of ductility requirements.

Some general directions for the determination of global scantlings may also be given to provide adequate resistance to the loads concerned, such as:4

a) increase in scantlings of connections of primary members;

b) global balancing in redistribution of stiffness and masses;

c) redundancy in number of structural members and piles, so as to facilitate redistribution of stresses from the plastic deformation area to the adjacent areas and simultaneous formation of plastic hinges;

d) minimising of abrupt changes in section;

e) use of materials not subject to brittle fracture phenomena;

f) check that tubular members and piles which are more likely to be subject to plastic deformation have diameter/thickness ratios such as to satisfy the following equation:

$$D/t \leq 13{,}1 \cdot 10^6/\sigma_s$$

where σ_s = yield stress of the material, in kN/m^2.

2.1.3 Both simplified and detailed procedure adopted to determine seismic action as introduced in Part B, Chapter 3, [5.6.2], require the estimation of the *seismic reserve capacity factor*, C_r.

C_r is a factor depending on the characteristics of the designed structural system; it represents the static reserve strength or the ability to sustain large non-linear deformations, thus representing the structure's ability to sustain ground motions due to earthquakes beyond the level of ELE. It is defined (ref. ISO 19902:2007, Subclause 11.3) as the ratio of spectral acceleration which causes structural collapse or catastrophic system failure to the ELE spectral acceleration.

The value of C_r has a great influence on the economic aspects of the design, for this reason it should be estimated prior to the design of the structure so to ensure that the structure, besides resisting to an ELE, is at the same time likely to meet the ALE performance requirements.

Values of C_r may be justified by prior detailed assessment of similar structures.

For fixed steel offshore structures, the representative value of C_r may range from 1.10 to 2.80, estimated from the general characteristics of the structural design in accordance with Table 11.3-1 of ISO 19902:2007.

Still according to ISO 19902:2007, Subclause 11.3, if the values reported in Table 11.3-1 are not adopted, a value of C_r may be assumed based on previous experience, provided that both the following conditions are satisfied:

- if the simplified procedure has been used to determine the seismic action, the assumed value of C_r shall be lower or equal to:
  - 2,8 for L1 platforms;
  - 2,4 for L2 platforms;
  - 2,0 for L3 platforms.
- A non-linear time-history analysis is performed according to ISO 19902:2007, Subclause 11.6.4, to demonstrate its ability to withstand the ALE event, or, in alternative, a static pushover analysis is carried out in accordance with ISO 19902:2007, Subclause 11.6.3, to calculate the actual C_r and verify that it is exceeding the assumed one.

2.2 ELE Requirements

2.2.1 When subjected to the ELE, each platform structural component shall be designed to the ULS for strength by using the internal force (action effect) calculated according to the equations reported in ISO 19902:2007, Subclause 11.5.1, as a combination of permanent and variable loads G_1, G_2 and Q_1, described in Part B, Chapter 3, [4.2] and [4.3] respectively, which are reasonably certain to be present during a seismic event, and the inertia load, E, induced by the ELE ground motion and determined using a dynamic analysis procedure, such as response spectrum analysis or time-history analysis:

a) $F_d = 1.1\,G_1 + 1.1\,G_2 + 1.1\,Q_1 + 0.9\,E$,

and:

b) $F_d = 0.9\,G_1 + 0.9\,G_2 + 0.8\,Q_1 + 0.9\,E$,

when contribution to the internal force due to gravitational loads oppose the inertia loads due to the earthquake.

2.2.2 For ELE design, the platform's structure subject to base excitation from seismic events may be checked through one of the following analysis methods:

- The response spectrum analysis method;
- The time history analysis method.

According to ISO 19901-2:2004, Subclause 6.2.2, regardless of the method used, the base excitations shall be composed of three motions, i.e. two orthogonal horizontal motions and the vertical motion. Reasonable amounts of damping compatible with the ELE deformation levels are to be used.

The characteristics of ground motions used as a basis for the seismic analysis of the platform are to adequately represent the expected actual conditions of the considered area in terms of intensity, frequency content and energy distribution.

The effects of local soil conditions in amplifying or damping the ground motions and in altering the frequency content are to be considered.

Ground motions may be described in terms of both response spectrum and time histories.

2.2.3 The geometric-inertial representation of the platform-soil-water system is to effectively define the distribution of stiffness's, masses and damping's.

In particular, as far as masses are concerned, in addition to the mass of the structural members and associated equipment, the mass of the liquids contained in tanks and non-watertight tubular members located below the mean still water level is to be considered.

In general, a three dimensional model is to be used allowing account to be taken of torsional responses due to asymmetry in platform mass or stiffness distribution.

2.2.4 Structural dynamics and foundation modelling are to be carried out according to the provisions of ISO 19902:2007, Clause 11.5.2, as well as the following criteria, in compliance with ISO 19901-2:2004, Subclause 6.2.2, depending on the analysis method:

- In a response spectrum analysis, a number n of modes is to be considered such as to account for at least 90% of the total energy of all vibration modes of the system concerned. At least 6 modes having the highest energy content are to be included among the considered n modes; correlation between the modes of vibration shall be considered when the responses in the three orthogonal directions are combined. If each directional component of an earthquake are analysed separately, the responses due to the three earthquake directions may be combined through two different rules, the root of the sum of the squares method can be used or, alternatively, the linear sum assuming that one component is at its maximum while the other two components are at 40 % of their respective maximum values. In the second case, in order to carry out the analysis on the safe side, the sign of each response parameter shall be selected such that the response combination is maximized;
- In a time history analysis, a minimum of 4 sets of time history records shall be used to capture the randomness in seismic motions. The earthquake time history records shall be selected such that they represent the dominating ELE events. Component code checks are calculated at each time step and the maximum code utilization during each time history record shall be used to assess the component performance. The extreme level earthquake check is satisfied if for at least the half of the records the maximum code utilization is lower than 1,0. In order to increase the safety level of this approach, if less than 7 sets of records are employed, a further scale factor of 1,05 shall be applied to the records.

2.2.5 Equipment on the deck shall be designed to withstand the deck motion as determined from ground motion transmitted through the structure and eventually amplified. According to ISO 19901-2:2004, it is recommended to obtain deck motions, especially relative motions, and deck motion response spectra from a time history analysis.

2.2.6 The effect of ELE-induced motion shall be taken into account also for pipelines, conductors, risers and other safety-critical components.

2.3 ALE Requirements

2.3.1 Besides the capability to provide strength and stiffness requirements when subjected to ELE, the platform structure-foundation system shall be designed to meet energy dissipation requirements, i.e. to sustain possible considerable damage during the ALE event but preventing its final collapse.

During the ALE event, the structural integrity of the topside shall be also maintained.

2.3.2 During an abnormal level earthquake, ALE, major non-linear behaviours of the structure are permitted because, in most cases, it would be not economical to design a structure able to withstand ALE event without non-linar behaviour. Hence, to demonstrate the ALE performance can require a non-linear analysis, also according to sesismic design requirements reported in Table 4 of ISO 19901-2:2004 (last column, here reported in the following Table 4.4), depending on the platform SRC.

SRC	Non-linear ALE analysis
1	None
2	Permitted
3	Recommended
4	Required

Table 4.4 – Non-linear analysis requirement.

2.3.3 Possible stiffness and strength degradation of components under cyclic action reversals shall be included in the analysis, furthermore the ALE analysis shall be based on best estimate values of modelling parameters such as material strength, soil strength and soil stiffness. Specifically, the structure-foundation model for checking the ALE performance is to be carried out according to ISO 19902:2007, Subclause 11.6.2.

2.3.4 According to ISO 19901-2:2004, the ALE design check may be performed with one of the following two methods of analysis:

- Non-linear static pushover analysis;
- The non-linear time history analysis method.

Considerations similar to those reported in [2.2.4] for the composition of base excitations from three orthogonal components of motion and for damping during ELE events, are still valid for ALE design procedures.

As already stated, the aim of the check is to ensure that the structure-foundation system can withstand the rare, intense ALE earthquake, avoiding the global collapse of the structure.

It is not possible to define a calculation procedure such as to meet the purpose of this check in consideration of the complexity of phenomena which may occur.

In addition to the redistribution of stresses due to plastic deformations of parts of the platform, foundations and even of soil, a considerable variation of dynamic behaviour of the structure occurs, due to variation of natural frequencies and hence of vibration modes, in connection with the change of distribution of stiffness's.

A possible solution to the problem in the elastic field is to consider the structure loaded by a system of lateral loads representing the shear distribution in the modal analysis for the maximum allowable earthquake in respect of yield and local buckling.

By gradual proportional increases of these horizontal forces the collapse is reached and the amount of energy absorbed up to that state may be evaluated.

The collapse may be defined as excessive deformation, buckling or global collapse of the platform.

As this procedure is in the elastic field, it will be necessary to replace the yielded or buckled members with forces and/or moments which represent their residual strength.

2.3.5 A non-linear static pushover analysis aimed to determine the smallest value of the seismic reserve capacity factor among those computed for different directions of seismic action pattern may be carried out according to ISO 19902:2007, Subclause 11.6.3, with possible estimation of C_r given by (ref. Equation (11.6-1) of ISO 19902:2007):

$$C_r = C_{sr}\, C_{dr}\,,$$

where C_{sr} and C_{dr} are calculated according to Equations (11.6.-2) and (11.6.3) of ISO 19902:2007, respectively.

2.3.6 In case that the non-linear time history analysis method is adopted, a minimum of 4 time history analyses shall be used (ref. ISO 19902:2007, Subclause 11.6.4) to capture the randomness in a seismic event. The earthquake time history records shall be selected such that they represent the dominating ALE events. If 7 or more time history records are used, global structure survival shall be demonstrated in half or more of the time history analyses. If fewer than 7 time history records are used, global survival shall be demonstrated in at least 4 time history analyses.

2.4 Topside requirements

The seismic analysis of the platform is to include a dynamic response analysis of arrangements and equipment located on deck or other areas of the platform.

Such analysis is intended to check that:

1) supports and lashing provided are suitable to withstand the dynamic loads;
2) arrangements and equipment are not damaged;
3) inclinations and movements to which arrangements and equipment are subjected do not become dangerous for personnel on the platform.

Reference can be also made to ISO 19902:2007, Subclause 11.7 for topsides appurtenances and equipment seismic assessment.

3 Structural analysis

3.1 General requirements

3.1.1 Calculations relevant to structural analysis are to be submitted to Tasneef together with sufficient documentation and are to be performed for all the design phases of the platform.

3.1.2 For approval and relevant certification purpose scantlings of structures are to be based on the criteria outlined in these Rules or other equivalent criteria reported in applicable international standards deemed acceptable by Tasneef.

3.1.3 For structural modelling and analysis requirements general reference can be made to ISO 19902:2007, Clause 12.

3.2 Purpose of structural analysis

3.2.1 For each loading condition discussed in Section 1 relevant to the following design situations:

a) pre-service situations, including fabrication, loadout, transportation and installation (ref. [1.3]);

b) in-place situations, including:
   - permanent, variable and environmental loadings (ref. [1.2]);
   - accidental siuations (ref. [1.5]);
   - seismic events (ref. [2.1]);

c) removal situations (ref. [1.4]),

as well as in the case of structure reuse (ref. ISO 19902:2007, Clause 25), relevant effect in the platform structure shall be determined in terms of:

- internal section forces, and relevant stresses in the structural components, which shall not exceed the resistance of the components in terms of:
    - o material yielding and ductile fracture;
    - o overall or local buckling;
    - o fatigue;
    - o brittle fracture,
- displacements and vibrations, which shall be limited in order not to affect the platform serviceability;
- support reaction to verify the required foundation capacity,

based on specified loads and applicable partial load factors reported in Section 1.

3.2.2 To determine the total stress levels, the local stresses including, when applicable, those due to circumferential loads acting on tubular members are to be added to primary stresses calculated for the prescribed design loading conditions.

3.2.3 When computing bending stresses on ordinary stiffeners of deck and side plating and on girders, the effective sectional area is to be calculated in accordance with "effective width" concepts acceptable to Tasneef.

3.2.4 The effect of notches and other structural details which may cause stress concentrations is to be carefully taken into account in the design of structures.

3.2.5 For structural members within the "splash zone" as defined in Part D, Chapter 6, [1.1.4], the thickness reduction due to corrosion is to be considered.

The amount of such reduction is to be decided case-by-case depending on the characteristic environmental factors, the materials used and the arrangements adopted for corrosion prevention, but in no event it is to be assumed less than 5 mm.

For elements located above the mean still water level, the above-mentioned reduction may be shortened up to zero, provided that in the Operating Manual periodical maintenance of the splash zone protective coating is foreseen which is suitable in the opinion of Tasneef for preventing coating deterioration and the protective coating is not subject to removal risks due to impacts or abrasions.

3.3 Structural analysis requirements

3.3.1 Calculation methods and tools used for the determination of loading effects shall be state-of-the.art recognized methods or validated by previous experience and standard practice.

Both linear elastic and non-linear analysis may be used as appropriate and in accordance with ISO 19902:2007, Subclause 12.2.2.

3.3.2 Specific guidance on modelling of the structure, its components, their interaction and support conditions, focused on steel jacket tubular frame structures, is provided in ISO 19902:2007, Subclause 12.3, in consideration of:

- member modelling;
- joint modelling
- material properties;
- topsides structure modelling;
- appurtenances;
- foundation system modelling;
- conductor modelling.

Provisions for local (ref. Subclause 12.3.9) and dynamic analysis (ref. Subclauses 12.3.11 and 12.3.12) structural models are also reported in ISO 19902:2007.

3.3.3 The types of analysis possibly applicable for the different design situations are summarized in Table 12.4-1 of ISO 19902:2007. Then, specific requirements for the different situations are provided in Subclause 12.4.3 and Subclause 12.4.4 for pre-service (or removal) and in-place situations respectively.

Finally, reference can be made to Subclause 12.5 (linear analyses) and Subclause 12.6 (non-linear analysis) of ISO 19902:2007 for the provisions relevant to the type of analysis appropriately selected as to be carried out.

4 Tubular members checks

4.1 General requirements

The requirements provided in this section, according to ISO 19902:2007, Clause 13, applies to unstiffened and ring stiffened cylindrical tubular members having:

- wall thickness exceeding 6mm;
- outer diameter to wall thickness ratio not exceeding 120;

- material properties meeting the general requirements of ISO 19902:2007, Clause 19, or those reported in Part D, Chapter 1, with the following conditions to be respected anyway:
    - o yield strength not exceeding 500 MPa;
    - o ratio of yield strength as used to ultimate tensile strength not exceeding 0,9.
- constructed in compliance with the fabrication tolerances given in ISO 19902:2007, Clause 21, or those reported in Part D, Chapter 3.

4.2 Tubular members subjected to single action effect

4.2.1 Axial Tension

(Ref. ISO 19902:2007, Subclause 13.2.2; equation (13.2-1)).

Tubular members subjected to axial tension forces shall have maximum utilization factor, calculated all along their cross-sections, according to Equation (13.2-2) of ISO 19902:2007, not exceeding 1 for all the applicable design loading conditions.

4.2.2 Axial compression

(Ref. ISO 19902:2007, Subclause 13.2.3; equations (13.2-3) and relevant (13.2-5) or (13.2-6), depending on (13.2-7) and relevant (13.2-8) or (13.2-9), depending on (13.2-10), and (13.3-5) or (13.3-6)).

Tubular members subjected to axial compression forces shall have maximum utilization factor, calculated all along their cross-sections, according to Equation (13.2-4) of ISO 19902:2007, not exceeding 1 for all the applicable design loading conditions.

Provisions for determination of applicable effective length factors are reported in ISO 19902:2007, Subclause 13.5 and applicable Table 13.5-1 (which also provides moment reduction factor for member strength checking for combined axial compression and bending, ref.[4.3.3]).

4.2.4 Bending

(Ref. ISO 19902:2007, Subclause 13.2.4; equations (13.2-11) and (13.2-13) or (13.2-14) or (13.2-15)).

Tubular members subjected to bending moments shall have maximum utilization factor, calculated all along their cross-sections, according to Equation (13.2-12) of ISO 19902:2007, not exceeding 1 for all the applicable design loading conditions.

4.2.4 Shear

(Ref. ISO 19902:2007, Subclause 13.2.5; equations (13.2-16) and (13.2-18)).

Maximum beam shear stress and torsional shear stress are to be evaluated and verified according to the provisions reported in ISO 19902:2007, Subclauses 13.2.5.1 and 13.2.5.2 respectively.

4.2.5 Hydrostatic pressure

(Ref. ISO 19902:2007, Subclause 13.2.6).

Submerged tubular members (not flooded in any of the design situations) are to be checked under the effect of hydrostatic external pressure to guarantee appropriate safety against local hoop buckling condition according to Equation (13.2-22) of ISO 19902:2007.

Capped-end stresses due to axial components of hydrostatic pressure are to be included in the analyses and included in the checks reported in [4.3.4] and [4.3.5] as applicable according to the formulation reported in ISO 19902:2007 Subclause 13.4.1.

Stiffening rings, if required, are to be designed according to the provisions of ISO 19902:2007, Subclause 13.2.6.3.

4.3 Tubular members subjected to combined action effects

4.3.1 P-˜ Effects

P-˜ effects shall be taken into account in terms of bending stresses relevat to secondary moments associated to factored global action only if relevant, according to the recommendations provided by ISO 19902:2007 in Subclause 13.3.1.

Furthermore, P-˜ effects are to be taken into account for the verification of foundation piles against overall column buckling if relevant, according to ISO 19902:2007, Subclause 13.3.4.

4.3.2 Axial tension and bending

(Ref. ISO 19902:2007, Subclause 13.3.2; equation (13.3-1)).

Tubular members subjected to combined axial tension and bending forces shall have maximum utilization factor, calculated all along their cross-sections (by using the definitions reported in Subclauses 13.2.2 and 13.2.4), according to Equation (13.3-2) of ISO 19902:2007, not exceeding 1 for all the applicable design loading conditions.

4.3.3 Axial compression and bending

(Ref. ISO 19902:2007, Subclause 13.3.3; equations (13.3-3) and (13.3-4) depending on (13.3-5) and (13.3-6)).

Tubular members subjected to combined axial compression and bending forces shall have maximum utilization factor, calculated all along their cross-sections (by using the definitions reported in Subclauses 13.2.3, 13.2.4, 13.3.2 and 13.5), according to either Equation (13.3-7) or (13.3-8), whichever is the greatest, of ISO 19902:2007, not exceeding 1 for all the applicable design loading conditions.

4.3.4 Axial tension, bending and hydrostatic pressure

(Ref. ISO 19902:2007, Subclause 13.4.2; equations (13.4-7) depending on (13.4-8), (13.4.9), (13.4-10) and (13.4-11)).

Tubular members subjected to combined axial tension, bending and hydrostatic pressure shall have maximum utilization factor, calculated all along their cross-sections (by using the definitions reported in Subclauses 13.2, 13.3, 13.4.1 and 13.4.2), according to Equation (13.4-12) of ISO 19902:2007, not exceeding 1 for all the applicable design loading conditions.

4.3.5 Axial compression, bending and hydrostatic pressure

(Ref. ISO 19902:2007, Clause 13.4.3; equations (13.4-13) or (13.4-14) depending on (13.4-15) or (13.4-16) or (13.4-17) and (13.4-18)).

Tubular members subjected to combined axial compression, bending and hydrostatic forces shall have maximum utilization factor, calculated all along their cross-sections (by using the definitions reported in Clauses 13.4.3, 13.2.6.2 and 13.2.3.3), according to Equation (13.4-19) or (13.4-20) or (13.4-21), whichever is the greatest, of ISO 19902:2007, not exceeding 1 for all the applicable design loading conditions.

4.4 Special considerations for tubular members

4.4.1 Conical transition

For conical transition design and checks the requirements of ISO 19902:2007, Subclause 13.6, shall apply.

4.4.2 Dented tubular members

Recommendations for structural strength checks of dented structural members to be applied in particular during the assessment of existing structures are reported in ISO 19902:2007, Subclauses 13.7.2 to13.7.3, provided the dent depth dimensions are within the limitations reported in Subclause 13.7.1.

4.4.3 Corroded tubular members

A methodology for estimating residual strength of corroded tubular members is addressed in ISO 19902:2007, Appendix A.13.8.

4.4.3 Grouted tubular members

Fully grouted tubular members checks, according to the definitions reported in ISO 19902:2007, Subclause 13.9.1 are to be strength checked according to the provisions reported in ISO 19902:2007, Subclauses 13.9.2 and 13.9.3.

5 Tubular joints checks

5.1 General requirements

Tubular joints are of primary importance for the structures covered by these Rules. They are to comply with special design requirements, to minimise the occurrence of stress concentrations or crack initiations, and with special structural strength requirements to prevent punching shear.

5.2 Design

5.2.1 Material requirements

Material of tubular connections shall comply with general requirements addressed in Part D, Chapter 1 and specific requirements to the strength of tubular connections reported in Subclause 14.2.1 of ISO 19902:2007, with particular attention paid to:

- Ratio between yield and ultimate tensile strength requirements;
- Through-thickness toughness requirement for chord material.

5.2.2 Minimum strength

For new structures, joints for all primary structural members shall be designed to ensure that their strength is not lower than the member strength of the adjoining braces (ref. ISO 19902:2007, Subclause 14.2.2).

This condition shall be ensured, in addition to the requirement for the strength of the joint, which is discussed in the following [5.3], by satisfying the check reported in the Equations (14.3-12) and (14-3-13) of ISO 19902:2007.

5.2.3 Detailing practice

(See also ISO 19902:2007, Subclause 14.2.5)

Simple tubular joints without overlapping are to comply with the following requirements:

a) if increased wall thickness or special steel is required in the chord of the joint, it is to extend past the outside edge of the bracing for a minimum of 1/4 of the chord diameter or 300 mm, whichever is the greater (see Figure 4.1);

b) when increased wall thickness or special steel is used for braces in the tubular joint area, it is to extend a minimum of one brace diameter or 600 mm, whichever is the greater, from the joint (see Figure 4.1);

c) the minimum distance between the imprints of braces on the chord surface is to be not less than 50 mm (see Figure 4.1);

d) when the distance between the intersection of centrelines of two braces with the chord centreline is higher than 1/4 of the chord diameter (see Figure 4.1), the calculation of stresses is to take account of the bending moments induced by such offset.

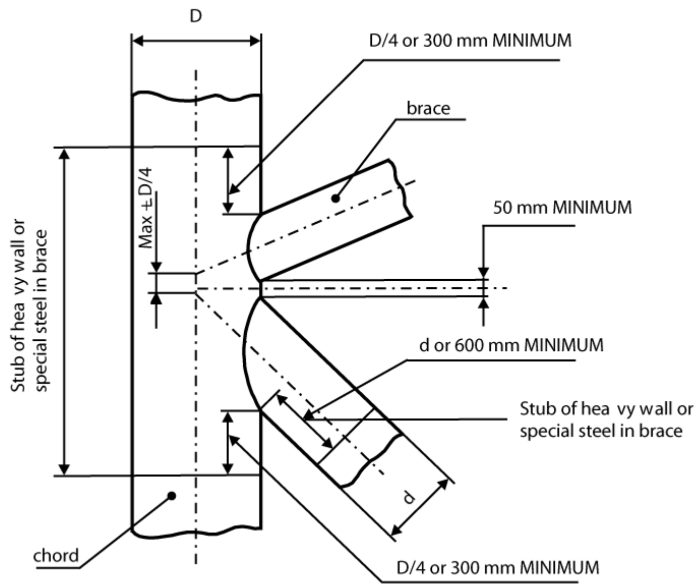


Figure 4.1

Overlapping joints in which part of the load is transferred directly from one brace to another through their common weld are to comply with the following requirements:

a) the overlap is preferably to be proportioned to transfer at least 50% of the allowable total load component perpendicular to the chord;

b) in no case is the brace wall thickness to exceed the chord wall thickness;

c) the thicker or the more loaded of the two braces is to have its full circumference welded to the chord (see Figure 4.2).

When more than two braces tend to overlap in congested joints, the following corrective measures may be considered (see Figure 4.2):

a) the thicker braces may be made the through members and the remainder designed as overlapping members;

b) the chord may be given an enlarged joint section;

c) spherical joints may be used;

d) secondary braces causing interference may be spread out.

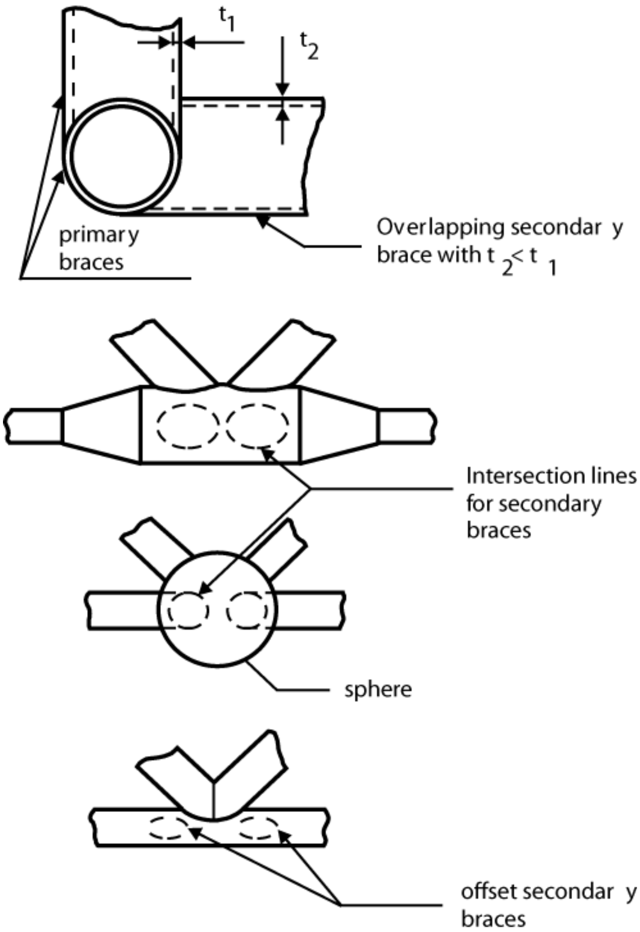


Figure 4.2

To improve the fatigue strength of tubular joints, the following measures are to be adopted:

a) the design is to be aimed at minimising stress concentrations;

b) welding is to be performed with single beads starting at chord and brace and making the last bead in the middle of the weld to avoid excessive hardness; the "weave technique" (i.e. moving the electrode from edge to edge to fill a large groove in a single run) is to be avoided;

c) fillet welds are to be used only for members not subjected to significant fluctuating stresses; the weld profile is to be concave and tangent to the connected surfaces and an acceptable penetration is to be ensured.

The following may also be considered:

d) filling of the chord with concrete or other rigid material to reduce local deformations and hence high peak stresses;

e) grinding of the weld toes to a smooth profile tangent to chord and brace surfaces (see Figure 4.3 and Figure 4.4).

One side welding in single V-groove may be accepted only for brace thickness less than 38 mm and angle greater than 35°.

Figure 4.3-a shows a typical example of single V-groove preparation.

However, a fabrication scheme making back welding possible is preferable, because it improves penetration and fusion and reduces the probability of root defects (see Figure 4.3-b).

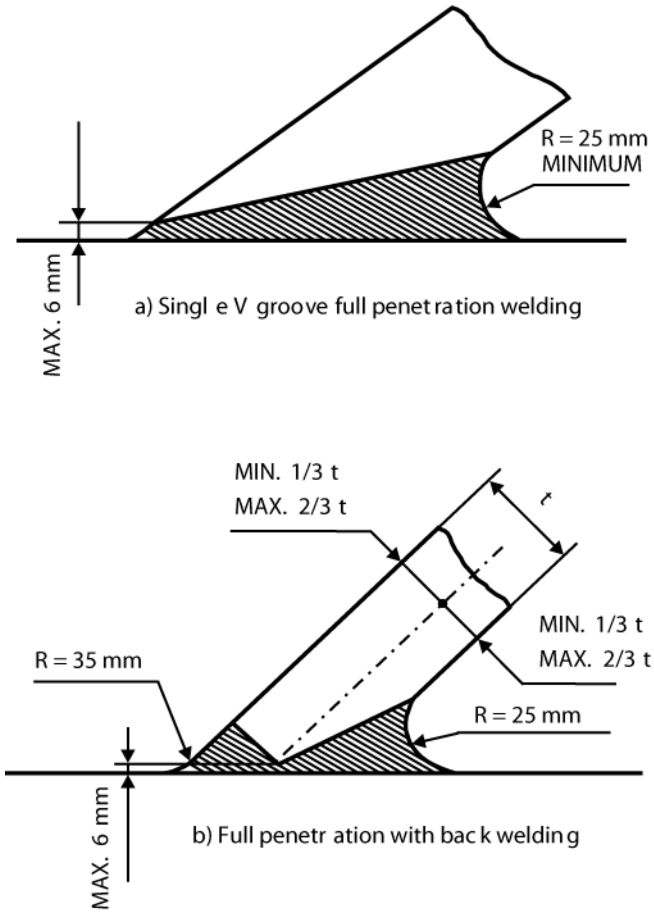


Figure 4.3

Intersection of welding seams is to be avoided, as far as practicable.

In the hatched area of Figure 4.5, having width twice the chord thickness and in the area of the braces limited by a line drawn at a distance twice the brace thickness from the brace-chord or brace-brace weld toe, welding of secondary members such as anode brackets or other fittings is to be avoided.

If this is not practicable, heat treatment of the welded area and grinding of welding seams are to be arranged.

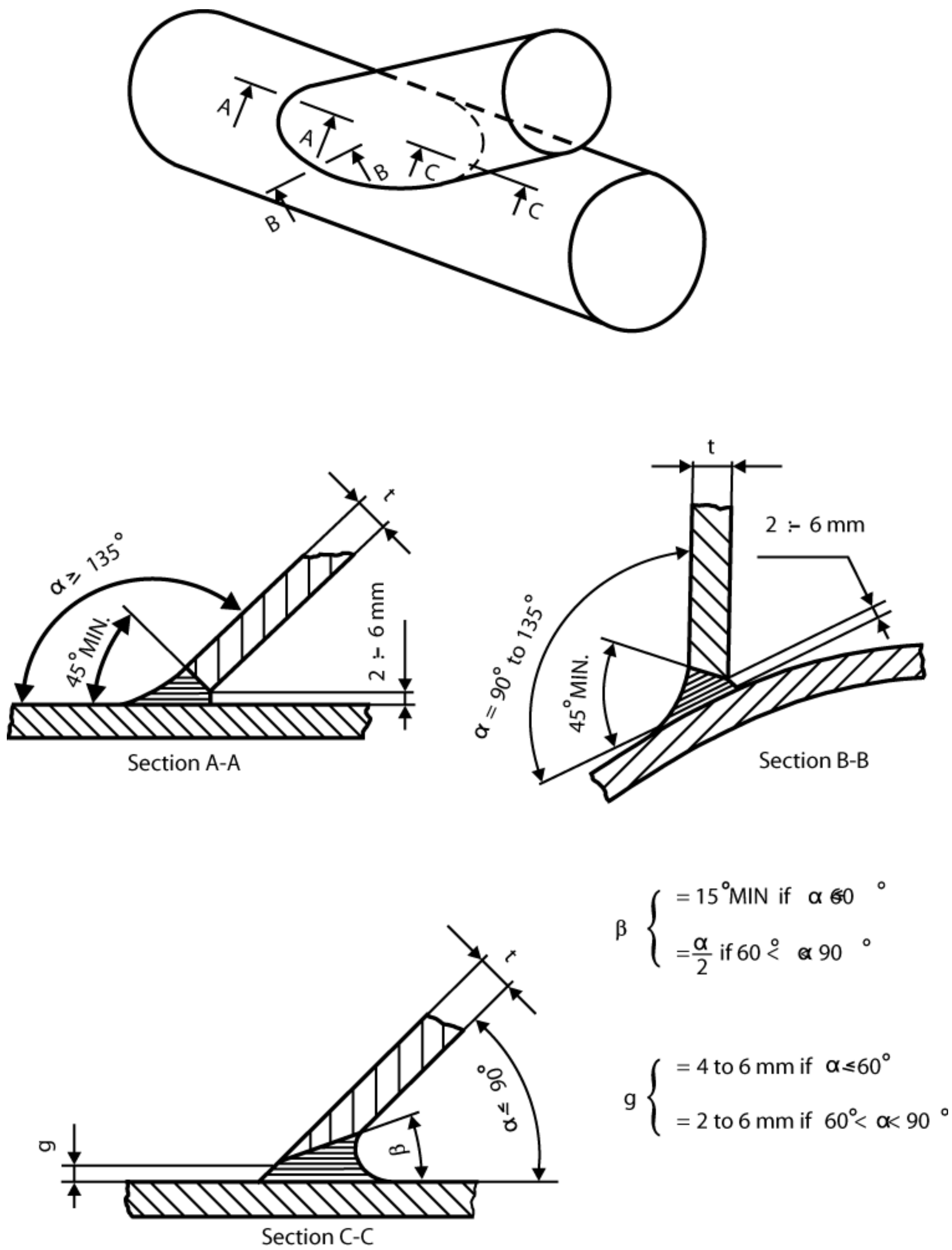

A
A
B
C
B
C
t
α ≥ 135°
45° MIN.
2 ÷ 6 mm
Section A-A
t
2 ÷ 6 mm
α = 90° to 135°
45° MIN.
Section B-B
β
= 15° MIN if α ≤ 60°
= α/2 if 60° < α 90°
g
= 4 to 6 mm if α ≤ 60°
= 2 to 6 mm if 60° < α < 90°
t
α ≤ 90°
β
g
Section C-C

Figure 4.4

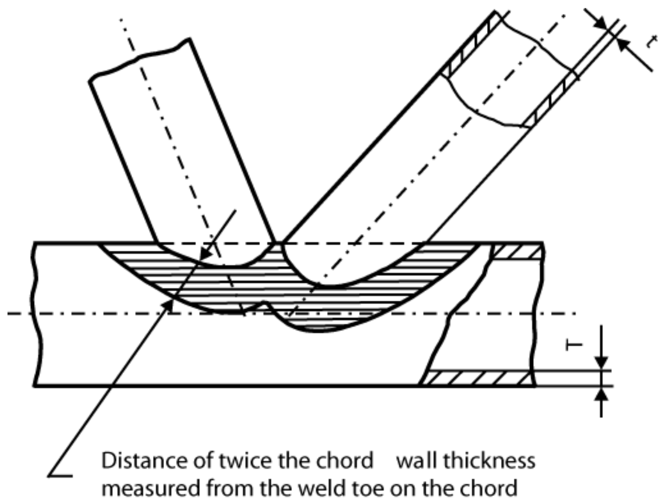


Figure 4.5

5.3 Structural strength

5.3.1 Simple joints

Simple tubular joints are joints pertaining the three basic planar types, i.e. Y-, K- and X-joints classified, on the basis of the axial forces in the braces, according to the definitions and principles reported in Subclause 14.2.4 of ISO 19902:2007, having no gussets, diaphragms, grout or stiffeners.

Simple Y- and X-joints have no overlap of principal braces, but simple K-joints may have overlaps up to 0.6 D, where D is the chord outside diameter.

Simple tubular joints shall be strength checked according to Equations (14.3-12) and (14.3-13) of ISO 19902:2007, with the validity ranges reported in ISO 19902:2007, Subclause 14.3.1, following to the calculation of:

- The strength factor Q_u and the chord force factor Q_f according to Subclauses 14.3.3 and 14.3.4 respectively;
- The representative joint axial strength P_{uj} and bending moment strength M_{uj} according to Equations (14.3-1) and (14.3-2) respectively, by weighting the contribution from Y-, K- and X-joint behaviour by the proportions of that behaviour in the joint (for the different load cases), and taking into account that, for Y- and X-joints with a chord can, P_{uj} shall be limited to the value calculated using Equation (14.3-11) and relevant definitions of Subclause 14.3.5;
- The design values of the joint axial strength and bending moment axial strength according to Equations (14.3-3) and (14.3-4) respectively.

5.3.2 Overlapping joints

Overlapping circular tubular joints shall be checked according to the provisions of ISO 19902:2007, Subclause 14.4.

5.3.3 Grouted joints

Grouted circular tubular joints shall be checked according to the provisions of ISO 19902:2007, Subclause 14.5.

6 Other type of joints

Joints not covered by the above provisions, [5.3.1] to [5.3.3], may be checked for strength and fatigue according to applicable recommendations of ISO 19902:2007, Subclauses from 14.6 to 14.10 or recognized standard codes and design practice subject to Tasneef approval.

7 Grouted connections

See ISO 19902:2007, Subclause 15.1.

8 Mechanical connections

See ISO 19902:2007, Subclause 15.2.

9 Clamps for strengthening and repair

See ISO 19902:2007, Subclause 15.3.

10 Fatigue assessment

10.1 General

10.1.1 Fatigue limit state (FLS) shall be verified according to ISO 19902:2007, Clause 16, for all the structural details of the platform possibly sensitive to fatigue damage accumulation, in particular (see also ISO 19902:2007, Subclause 16.2.1):

- Welded connection or connection joined by other means than welding;
- Structural discontinuity;
- Structural members on which stress concentrations are expected.

10.1.2 The fatigue assessment of the structural members is to be carried out covering their entire life, including pre-service conditions as well as removal.

For the purpose of a fatigue assessment the design service life shall be specified by the owner, based on a period of time not shorter than that anticipated for the platform operating life at its offshore place, including temporary situations when significant, and not less than 10 years according to Subclause 16.2.4 of ISO 19902:2007.

In general, the definition reported in ISO 19900 applies to design service life: "The assumed period during which a structure is to be used for the intended purpose with anticipated maintenance, but without substantial repair being necessary"

Considerations for fatigue damage incurred prior to the design service life are reported in ISO 19902:2007 Subclauses 16.13.4 and 16.13.5 for fatigue during transportation and installation respectively.

10.1.3 FLS refer to cumulative damage caused by repeated time-varying actions, particularly, but not limited to, wave actions, regarding to which a proper characterization of the long term wave environment is required and specifically discussed at Subclause 16.3 of ISO 19902:2007.

Fatigue damage due to causes other than wave action in the in-place situation are described in Subclauses 16.13.2 and 16.13.3 regarding the most relevant ones, i.e. vortex induced vibrations and wind induced vibrations respectively.

10.2 Fatigue analysis

10.2.1 Analysis criteria

The analysis criteria to be used for the fatigue assessment are to be acceptable to Tasneef; in general, two different categories of analysis methods exist:

a) methods based on fracture mechanics;
b) methods based on the evaluation of the cumulative damage.

In any case it has to be demonstrated that the fatigue limit state will not be reached in the design life for any of the structural components of the platform.

Fracture mechanics methods are specifically used for determining the residual life of components in which a defect has been detected in terms of developed crack, thus during the assessment of existing structures.

10.2.2 Fatigue assessment procedure

Normally, during the design phase, the fatigue assessment is performed by cumulative damage analysis, i.e. by using S-N data and Palmgren-Miner's rule. In this case the assessment is to be carried out through the following main steps:

- Long term description of the environment;
- Long term evaluation of the local stress range determination;
- Determination of the cumulative fatigue damage along the considered period, which can be, e.g., the service life for the in-place condition or the voyage duration of an ocean tow for the condition.

which are to be carried out in compliance with what addressed in the following points [10.2.3] to [10.2.7], by making specific reference to ISO 19902:2007 Subclauses from 16.3 to 16.12.

10.2.3 Long term description of waves

Long term wave distribution is to be defined as appropriate input data for the fatigue assessment according to ISO 19902:2007, Subclause 16.3.

The most suitable representation of the long term wave environment is the wave scatter diagram (ref. ISO 19902:2007, Subclause 16.3.2) with appropriate consideration given to:

- wave incoming direction information (see Subclause 16.3.3);
- wave spectrum shape formulation (e.g. Pierson-Moskowitz or Jonswap) for given sea state (see Subclause 16.3.4);
- wave directional spreading function (see Subclause 16.3.5).

10.2.4 Long term local stress range history

The long term stress range history is normally specified in the form of statistical distribution of the stress variations occurring at specified structural detail, since the time sequence of the sea states affecting the fatigue damage has no significant impact on the assessment.

According to ISO 19902:2007, Subclause 16.2.7 the long term stress range history can be determined by:

- a series of spectral analyses if a spectral fatigue analysis method (ref. Subclause 16.7) is used;
- a series of deterministic analyses if a deterministic fatigue analysis (ref. Subclause 16.8) is used;
- other approximate procedures (ref. Subclause 16.9), to the extent that they are introduced according to Subclause 16.6 and considered acceptable by Tasneef.

Independently of the analysis method used for the fatigue assessment (e.g. spectral or deterministic) a large series of global analyses of the platform subject to individual periodic waves are to be carried out to calculate the nominal stress ranges in the vicinity of the structural connections which are subject of the fatigue damage evaluation.

Relevant structural model shall be further detailed with respect to the model used for the strength analysis.

For description of specific features required for the stress analyses needed for the fatigue assessment reference can be made to ISO 19902:2007, Subclause 16.4.

Geometric stress ranges (GSRs) are then to be determined at specific locations of the connection (that is done, e.g. for tubular connections, by multiplying the nominal stresses, output of the above mentioned structural analyses, by stress concentration factors (SCFs)) according to the provisions of ISO 19902:2007, Subclause 16.10.

10.2.5 Fatigue resistance characterization

Fatigue resistance of the material is represented via S-N curves, whose basic features are given in Table 16.11-1 of ISO 19902:2007 for the different types of joints (tubular, TJ, cast, CJ, or other, OJ).

Material thickness effect shall be taken into account according to Subclause 16.11.4.

10.2.6 Cumulative damage evaluation

In order to evaluate the fatigue damage ratio D along the time T of exposure to variable actions of the structural components, the Palmgren-Miner formula, Equation (16.12-1) of ISO 19902:2007, may be used.

Then, the fatigue life L may be calculated by (ref. Equation 16.12-2):

$$L = T/D$$

In case that prior fatigue damage has occurred, as in the case of fatigue accumulation due to prior structure use or situation (e.g. transportation or ocean tow), the remaining fatigue life for the new design condition is to be calculated according to Equation (16.12-3).

10.2.7 Fatigue damage evaluation

A safety margin is introduced in the evaluation of the fatigue damages (and consequently in the relevant fatigue lives) carried out with the Equation (16.12-1) by introducing a fatigue damage design factor γ_{FD}, whose values are provided for in situ conditions in Subclause 16.12.2 of ISO 19902:2007 depending on both the failure consequences (or structural component criticality) and in-service inspectability.

The adopted values of the fatigue damage design factor shall be subject of appropriate definition in the platform project design premises and submitted to Tasneef for approval; in lack of more detailed determination the following recommendations provided by ISO in Subclause 16.12.2 shall be taken into account:

- γ_{FD} shall not be taken as less than 1.0 for new design;
- a value of γ_{FD} = 2.0 is recommended for inspectable and non-failure critical locations;
- for failure-critical and/or non-inspectable locations, γ_{FD} values of up to 10.0 are recommended (the upper limit to be intended as applicable for failure-critical and non-inspectable locations);

Inspectability means meeting the in-service inspection requirements detailed in Clause 23 of ISO 19902:2007.

Finally, in the same evaluation (Equation (16.12-1) of ISO 19902:2007) of the fatigue damage, a local experience factor kLE may be introduced according to Subclause 16.12.3 to take into account local actual experience with existing structures, provided that this experience is directly relevant to the situation being considered and the adopted value of kLE fully documented and supported by reliable evidence (see also A.16.12.3 of ISO 19902:2007).

10.3 Fatigue improvement

Weld improvement techniques (ref. Subclause 16.16 of ISO 19902:2007) shall not be used at design stage but can only be adopted when the project is too far advanced so that design changes are impracticable (see Subclause 16.2.11 of ISO19902:2007) or to improve fatigue lives of structural components of existing structures (see Subclause 16.1.6 of ISO19902:2007).

10.4 Fatigue assessment of existing components

Fatigue limit state (FLS) verification of fatigue sensitive components of existing structures shall be performed, rather than on a fatigue assessment based on long-term stress range predictions and S-N curves methodology recommended for design of new structures, based on fracture mechanics methods or on methods capable to implement actual inspections results.

Fatigue reliability methods are particularly recommended since they are capable to provide:

- an estimation of the fatigue safety index which is time dependent, therefore suitable to be updated following to the inspection outcomes;
- a rational basis for future inspection plan adequate to maintain the acceptable safety target with respect to possible required extension life of the existing platform.

11 Topside structural design

11.1 Reference standard and design format

Topsides structural design shall be performed in compliance with ISO 19901-3:2010, with the specific design possibly carried out based on national or regional building codes, according to Subclause 5.2.2 of ISO 19901-3:2010, provided that a common level of reliability is ensured to both sub- and topside structures of the platform.

To this aim limit state or LRFD (load and resistance factor design) method shall be adopted by taking action factors according to those reported in Section 1 for support structure and resistance factors possibly taken from national or regional building code modified by the application of a building standard correspondence factor, as reported in ISO 19901-3:2010, Subclause 8.1.

11.2 Air gap or deck clearance

The elevation of the lowest deck, with relevant facilities or equipment, above sea water level shall be set to provide appropriate clearance to allow the passage of extreme or abnormal waves.

A safety margin or air gap is consequently required between the crest of the maximum design wave and the lowest point (beam, equipment or fixing) of the lowest deck.

Relevant minimum allowable deck elevation shall be determined according to ISO 19902:2007, A.6.3.3.2 or, in case that the requirement is not satisfied, the involved deck structure and supported facilities or equipment shall be designed to withstand the loads due to the impact of relevant hydrodynamic actions and to be capable to transmit such actions through the topsides to the supporting substructure (ref. ISO 19901-3:2010, Subclause 5.3).

Also the effect of any green water due to the inundation and running of the waves on the deck surface shall be investigated if applicable.

11.3 Design conditions

According to ISO 19901-3:2010, Subclause 6.3, the topside structures shall be designed to resist permanent, variable and environmental actions and combination thereof occurring during its service life, as well as temperature and deformation effects.

Applicable actions are to be defined according to Clause 7 of ISO 19901-3:2010. The actions shall include both actions directly applied to the topside and the effects (including dynamic effects if significant) of actions on the supporting structure (such as waves, currents and earthquakes).

If relevant, the effects of ice accretion (in increasing both weight and structural components dimensions resulting in increased wind actions, shall be included in the design loading conditions.

11.4 Design requirements

Overall minimum requirements for design of topsides structures are reported in corresponding Subclauses of ISO 19901-3:2010, to satisfy:

- ULS design requirements (ref. Subclause 6.6) to be complied with in both pre-service and in-place situations;
- SLS design requirements (ref. Subclause 6.5), which are to be particularly considered for topsides structures for limitation of deformations and/or vibrations during operations (i.e. in-place situation);
- FLS design requirements (ref. Subclause 6.7) to be complied with for applicable pre-service (e.g. long sea transportation prior to installation of a topside structure) and in-place situations (e.g. local design of members subject to vibrations or thermal variations);
- ALS design requirements with respect to accidental actions addressed in Subclause 7.10 (accidental situations).

11.5 Structural components checks

Structural strength checks of platform topside components are to be carried out according to the provisions of ISO 19901-3:2010, Clause 8 following to appropriate modelling of the topside structural system as per ISO 19901-3, Subclause 9.2.

As regards to the support structure interface model, any assumption made at the interface between the topsides and supporting substructure shall be documented to ensure that the whole platform safety is not affected by any differences in assumptions, as also recommended by ISO 19901-3:2010, Subclause 9.3.1.

11.6 Flare towers, booms, vents and similar structures

Structural design of these structures is to be carried out according to Subclause 9.4 of ISO 19901-3:2010, with particular regard to global and local dynamic behaviour.

11.7 Crane support structure

The design of the crane support structure, meaning the crane pedestal and its connections to the topsides primary steelwork, not including the slew ring or its equivalent, or the connections between the slew ring and the pedestal, is to be carried out according to the provisions of Subclause 9.6 of ISO 19901-3:2010.

11.8 Helidecks

Structural design of helicopter landing facilities is to be performed according to Subclause 9.5 of ISO 19901-3:2010, in addition to the requirements of the regulating authority for aviation in the region in which the platform is located.

PART B CHAPTER 5

FOUNDATIONS

1 General

Overall considerations are defined in the Subclause 17.1 of ISO 19902:2007. General requirements for foundation design are listed also in Subclauses 5.1, 5.2 and 5.3 of ISO 19901-4:2003.

1.1 Geotechnical data gaining and geoscience studies on location

1.1.1 Shallow geophysical investigation

See ISO 19901-4:2003, Subclause 6.2.

1.1.2 Geological modelling and identification of hazards

See ISO 19901-4:2003, Subclause 6.2

1.1.3 Geotechnical investigation

The design of foundations is to be based on information taken from the actual location, considering an area of sufficient extent to take account of tolerances due to errors relevant to final positioning of the platform.

The results of investigation on location are to be submitted to Tasneef for consideration and shall include:

a) information on when the investigation was carried out and by whom;
b) comprehensive description of equipment and procedures used for in situ and laboratory investigation;
c) results of the above investigation;
d) critical examination of possible sources of errors and limitations in the applicability of the results.

For each platform to be installed, a sea bed investigation is to be carried out for the purpose of revealing the presence of natural obstacles (rocks, deposits, etc.) or other types of obstructions (anchors, wrecks, etc.), the soil waviness height and the possible occurrence of sand dune displacements or sea bed alterations.

The investigation on location is to be sufficiently extensive to include all the soil layers and rock deposits which may influence the behaviour of the platform foundation.

The investigation may be carried out by one or a combination of the following principal methods:

a) geophysical methods;
b) in situ tests;
c) borings with sampling for laboratory tests.

The investigation is to supply data for the classification and description of deposits and parameters to be used in the check calculations for the most important soil layers.

1.2 Design principles

1.2.1 General

The analysis of foundations is to aim to prevent their total failure and local overstressing of members of the base structure.

The possibility of excessive deformations is to be independently evaluated.

Any type of analysis is to take account of scour.

The calculations are to cover both the installation and operation phases.

1.2.2 Characteristic properties of soil

The characteristic properties of each layer of soil are to be carefully evaluated on the basis of the results of in situ and laboratory tests, taking account of stress conditions in the sample during the tests and of the actual stress conditions in the layer considered. For more detailed consideration on data acquisition see [1.1].

1.2.3 Effects of pulsating loads

Where deemed necessary, the influence of load fluctuations on the soil properties is to be evaluated.

The effects of wave induced forces are to be considered for the following conditions:

a) a design storm during the installation phase and the consolidation period;
b) the 100-year storm;
c) the cumulative effect of several storms, including the 100-year storm.

Realistic assumptions are to be made regarding the duration and intensity of such storms.

In the case of platforms installed in seismically active geographical areas, the possible deterioration of soil properties due to the cyclic characteristic of the seismic actions is to be taken into consideration.

Such deterioration generally results in a reduction of shear strength of soil, which is to be considered in the design.

1.2.4 Stability

The stability should be analysed for shallow foundations ensuring equilibrium between design actions and design resistance. The principles are described in Subclauses 7.1 and 7.2 of ISO 19901-4:2003.

For clarity the main requests for stability analysis are described here below:

a) an effective stress stability analysis based on effective strength parameters of the soil and realistic estimates of the pore water pressures in the soil. Such method requires laboratory shear tests with pore pressure measurements;

b) total stress stability analysis based on total shear strength of the soil evaluated on representative soil samples which are to be subjected, as far as practicable, to the same loading conditions as corresponding elements in the soil.

1.2.5 Settlements and displacements

In the evaluation of settlements and displacements, the following are generally to be considered:

a) initial and secondary settlements;

b) differential settlements;

c) permanent horizontal displacements;

d) dynamic motions due to load fluctuations.

The evaluation of settlements of structures is essential for the design of foundation piles, risers, etc.

The tilt of the platform consequent to differential settlements of the foundation system, due to variations in the soil characteristics and/or preferential direction of application of external loads, is not to exceed the tilt which can be allowed for the serviceability and safety of the platform.

An alternative description for settlements and displacements for shallow foundations is reported in Subclause 7.8 of ISO 19901-4:2003.

1.2.6 Soil-structure interactions

The evaluation of sectional forces and moments, as well as of dynamic motions in the members of the foundation system, is to be based on an integrated analysis of the soil-structure interaction.

The analysis is to be based on realistic assumptions regarding the soil stiffness and the transfer to the soil of loads from structural members resting on the sea bed or penetrating into it.

1.3 Stability of sea bed

1.3.1 Slope stability

The analysis of slope stability is to consider the natural slopes, those due to the installation or the presence of the platform, the possible future variations of existing slopes during the design life and the effects of wave loads on the sea bed.

The slope stability is to be carefully evaluated in the presence of layers of soft clays and loose deposits of silt or sands as well as in seismically active geographic areas.

1.3.2 Hydraulic stability

In the case of platforms whose foundations are on soils subject to erosion and softening (reduction in the modulus of elasticity due to fluctuating loads), the possibility is to be analysed of:

a) reduction of soil bearing capacity due to hydraulic gradients and seepage forces;

b) formation of piping channels and consequent erosion in the soil;

c) local surface erosion in areas under the foundation due to hydraulic pressure variations resulting from environmental loads.

1.3.3 Scour

The risk of scour around the foundation is always to be taken into account, unless it can be proved that the foundation soil is not subject to scour for the expected range of water particle velocities.

To prevent the effects of scour, one of the following measures is to be taken:

a) materials placed around the platform as early as possible after the installation;

b) foundation system designed considering all materials which are not resistant to scour as having been removed;

c) direct inspection of sea bed close to platform foundations and provision of suitable means to quickly stop the development of any scour detected.

Materials placed on the sea bed to prevent scour are to have adequate weight and dimensions, such that they are not removed by currents and that they prevent soil erosion though without impairing the draining of overpressure caused on the layers by the loads imposed.

2 Pile foundations design

2.1 General requirements

Deep foundations for fixed offshore steel platform are usually intended as piles. The type of pile foundation differs since the installation method:

a) driven piles;

b) drilled and grouted piles;

c) belled piles;

d) vibro-driven piles.

Detailed description of pile foundations is given in Section 6.2 of API RP 2A-WSD – 21st Ed. or in Subclause 17.2 of ISO 19902:2007.

General requirements are reported in Subclause 17.3 of the ISO 19902:2007. The design strength of coupled structure/soil design model shall be in accordance with the criteria defined below or according to an applicable international standard to be adopted in accordance with Tasneef.

2.2 Analyses to be performed

2.2.1 General

The foundation pile is to be analysed on the basis of loads imposed by the platform and those due to its installation.

2.2.2 Loads from platform

As regards the loads imposed by the platform, the analysis is to consider the maximum values of axial and lateral loads and the actual restraint conditions of the soil.

The soil lateral reactions are to be represented by the (p-y) curves mentioned in [2.4], due account being taken of scour effects.

The transfer of the axial load from pile to soil may be assumed as proportional to the friction resistance between them, divided by the safety factors specified in [2.1.2], taking into account the provisions of [2.2.1] regarding the high deformations due to cyclic lateral loads.

In general, the instability analysis of the pile is not required unless there are justified reasons for considering that the pile is without lateral support on account of considerable scour phenomena, the presence of particularly yielding soils, high calculated lateral deformation, etc.

2.2.3 Loads during installation

The structural analysis of the pile during the installation phase is to include realistic evaluation of stresses induced by the various systems used.

In particular, for driven piles it is necessary to consider the static loads due to driving equipment weight and dynamic loads induced during driving operations, due attention being paid to bending moment caused by axial load eccentricity and to lateral deformation of the pile, magnified when high resistance layers are encountered or when the blow frequency of the hammer approaches the natural frequency of the pile-hammer elastic system.

2.3 Pile design criteria

2.3.1 In the design of piles for foundations it is necessary to take account of the method used for their installation.

2.3.2 Where the transfer of loads from one pile to another or from a pile to the foundation soil is achieved by grouting, the surfaces are to be free from rust scales or other imperfections which may reduce the capacity of load transfer.

2.3.3 The design pile penetration is to be sufficient to provide adequate capacity to withstand the design compressive and tensile loads.

The foundation capacity is to be verified by the following two strength assessments, depending on the steps of the load transfer path generated from the structure to the soil.

a) Pile strength

The pile strength shall be carried out according to Part B, Chapter 4, Section 4.

Internal pile forces to be checked shall the ones due to the design actions according to the Part B, Chapter 3 using a coupled structure/soil non-linear foundation model. Take care to consider the column buckling effect on the pile in which case the lateral restrains of the soil is inadequate.

b) Pile axial resistance

The axial pile capacity shall be defined, in accordance with Equations (17.3-1) and (17.3-2) of ISO 19902:2007 ,as:

$$Q_{d,e} = \frac{Q_r}{\gamma_{R,Pe}}$$

$$Q_{d,p} = \frac{Q_r}{\gamma_{R,Pp}}$$

where:

$Q_{d,e}$: extreme design axial pile capacity;

$Q_{d,p}$: design axial pile capacity for permanent and variable actions or operating situations;

Q_r : representative value of the axial pile capacity as determined in [2.4];

$_{R,Pe}$: pile partial resistance factor for extreme conditions ($_{R,Pe}$= 1.25);

$_{R,Pp}$: pile partial resistance factor for permanent and variable actions or operating situations ($_{R,Pp}$ = 1.50).

The axial pile capacity shall satisfy the following conditions, as per Equations (17.3-1) and (17.3-2) of ISO 19902:2007:

$$P_{d,e} \leq Q_{d,e}$$

$$P_{d,p} \leq Q_{d,p}$$

Where the subscript 'e' means the design actions for the extreme conditions and the subscript 'p' represents the design actions for the permanent and variable actions or operating situations according to Chapter 3, [4.4.2].

The design bearing capacity of piles is to be limited to penetrations which have proved to be consistently obtained by experience; before installation, alternative solutions are also to be foreseen to be applied where design penetration cannot be obtained.

2.4 Pile capacity for axial compression

2.4.1 Ultimate bearing capacity

The ultimate bearing capacity of pile Q, in kN, is given by the equation:

$$Q = Q_s + Q_p$$

where:

Q_s : total skin friction resistance of pile, in kN, due to external and/or internal friction contribution. Equal to:

$$\sum f_i \cdot A'_{si}$$

Q_p : total end bearing capacity of pile, in kN:

$q\ A_p$

f_i : unit skin friction capacity in the i layer, in kN/m²;

A_{si} : external side surface area of pile in the i layer, in m²;

q : unit end bearing capacity of pile, in kN/m²;

A_p : gross end area of pile or annulus area of pile (it depends on the presence or not of the plug), in m²;

D_e : pile end external diameter, in m;

D_i : pile end internal diameter, in m;

In determining the ultimate bearing capacity of piles, consideration is to be given, when appropriate, to the weight of pile-soil plug system and to hydrostatic uplift.

The contribution of the total end bearing capacity (Q_p) and of the internal friction (Q'_s) shall not be considered both together.

If the pile is driven up to the target penetration depth the axial force shall not exceed the sum of the external friction contribution (Q_s) and the internal friction contribution (Q'_s) and the total end bearing capacity acting only on the pile wall annulus, or the sum of the external friction contribution (Q_s) and the end bearing capacity (Q_p) acting on the total end bearing area, whichever is lesser.

For open-ended pipe piles plugged, the total end bearing capacity, Q_p, shall not exceed the sum of the end bearing capacity of the internal plug and the end bearing on the pile wall annulus.

In computing the design actions in compression on the pile, the weight of the pile shall be considered.

Where a pilot hole is drilled, its end bearing area is to be discounted in computing the area A_p.

As a rule, for pile-bell systems the skin friction resistance of a portion of pile above the bell-shaped area having length of 3 pile diameters is to be neglected. If the pile-bell system is driven with a pilot hole, the area of the hole should also be discounted in computing the total bearing area of the bell.

If the pile is laterally loaded by cyclic loads and deformations imposed on the soil are rather high (higher than the quantity y_c defined in [2.4.2]), the friction resistance relevant to those layers of soil affected by such deformations is to be reduced or annulled.

2.4.2 Skin friction and end bearing capacity of piles in clay soils (cohesive soil)

a) For piles driven through clay, the unit skin friction capacity f is generally not to exceed the values given in Table 5.1 as a function of the undrained shear strength of the clay soil, c.

   For piles driven in undersized drilled holes or jetted (drilled by jetting of fluid under pressure) holes and for drilled and grouted piles in normally consolidated clay soils, f values are to be determined by reliable methods based on the evaluation of soil disturbance resulting from installation.

   In any case, the values given in Table 5.1 are not to be exceeded.

   For drilled and grouted piles in over-consolidated clay soils, f values may exceed those given in Table 5.1.

   In this case, careful consideration is to be given to the strength of the soil-grout and grout-pile skin interfaces (see [2.7]) also in relation to the amount and quality of drilling mud used.

b) The unit end bearing capacity of piles in clay soils q, in kN/m², may be determined, in general, by the equation:

   $q = 9c$

   Special consideration is to be given where the value of the shear strength of the soil in layers under the end of piles changes in an uneven way.

c (kN/m²)	f (kN/m²)
$c \le 24$	$f = c$
$24 < c < 72$	$f = \left(1,25 - \frac{c}{96}\right) \cdot c$
$c \ge 72$	$f = 0,5\ c$

Table 5.1 – Unit skin friction capacity f as a function of the undrained shear strength of the clay soil c.

The pile capacities computed above represent the long-term capacities. The axial capacity immediately after installation of piles is usually lower. The set-up of piles passes through the initial change of undisturbed soil condition due to the driven phase which generates pore overpressures. After that pure overpressures drift to dissipate and the soil drift is dependent on the development of pore pressures during installation phases and its consequent dissipation. The shortly application of design actions are important design consideration to be done in light of the lower axial capacity of pile immediately after installation.

2.4.3 Skin friction and end bearing capacity of piles in sandy and silty soils (cohesionless soil)

The unit skin friction capacity f, in kN/m², of piles driven in sandy and silty soils, except carbonate sands and gravels, may be determined by the following equation:

$$f = K \cdot p_o \cdot tg\delta$$

where:

K : coefficient of lateral soil pressure (ratio of horizontal to vertical normal effective stress);

p_o : effective overburden pressure of soil around pile at the depth in question, in kN/m²;

δ : friction angle between the soil and pile wall, in degrees.

K coefficient varies between 0,5 and 1 with the increase of the grade of sand density (the growth is not linear). In particular for open-ended piles driven unplugged, it is appropriate to assume K as 0.8 for both tension and compression loadings. When piles are plugged or close-ended the K coefficients may be assumed as 1.0.

The values of friction angle δ depend on the angle of internal friction of soil Φ in degrees and if other data are not available Table 5.2 may be used.

For close-ended or fully plugged open-ended piles values of "K tgδ" may be increased by 25%.

For long piles f may not indefinitely increase linearly with the overburden pressure p_o. In such case it is appropriate to limit f to the limiting skin friction values f_{lim} given in Table 5.2, dependent on the angle of internal friction of soil Φ in degrees.

f values from the above equation may be adopted even for open-ended piles driven unplugged in drilled and grouted holes.

For piles driven in undersized drilled holes or jetted holes, f values are to be determined by reliable methods based on the evaluation of soil disturbance resulting from installation and are not to exceed those for driven piles.

The unit end bearing capacity of piles q, in kN/m², in sand and silt soils, except carbonate sands and gravels, may be determined by the following equation:

$$q = p_o N_q$$

where:

N_q : bearing capacity factor;

p_o : effective overburden pressure of soil around pile at the depth in question, in kN/m².

N_q values depend on the angle of internal friction of soil Φ in degrees, in accordance with data given in Table 5.2.

For deep foundations q values may be lower than those given above.

For layered soils, N_q may be limited to values lower than those given in Table 5.2 and are to be determined on the basis of considerations regarding the local soil conditions.

SOIL TYPE	Φ (°)	δ (°)	N_q	f_{lim} (kN/m²)
Clean sand	35	30	40	114.8
Silty sand	30	25	20	95.7
Sandy silt	25	20	12	81.3
Silt	20	15	8	67.0

Table 5.2 – Foundation characteristics as a function of soil type.

Alternative method, based on CPT (cone penetration test) results, could be used to evaluate the skin friction and end bearing capacity as defined in the Annex A.17 of ISO 19902:2007.

2.4.4 Skin friction and end bearing capacity of piles grouted in rock

a) The unit skin friction capacity f, in kN/m², of grouted piles in rock may theoretically have an upper limit equal to the shear strength of the rock or of the grout. Actually, the f value may be considerably reduced in relation to the installation procedure and to the type of rock or of drilling fluid used.

   An upper limit of f value for this kind of pile may be given by the allowable bond stress between the pile wall and the grout mentioned in [2.7].

b) The end bearing capacity of the rock is to be determined from the shear strength of the rock itself and an appropriate bearing capacity factor, but in any case it is not to exceed 10000 kN/m². Another detailed method to define the end bearing capacity is given in the paper "Grouted piles in weak carbonate rock" by A.F. Abbs and A. D. Needham. presented at 17th Offshore Technology Conference, Houston 1985 (OTC Paper number 4852)

2.5 Pile capacity for axial pullout loads

The ultimate axial pullout capacity of pile is not to exceed the total skin friction of pile Q_s.

The effective weight of the pile, including the soil plug and hydrostatic uplift, is to be considered.

For clay soils, the unit skin friction capacity f is to have the same values given in [2.4.2].

For sandy and silty soils, the same considerations given in [2.4.3] are applicable, except that K = 0,5 is to be used.

For rock, see [2.4.4].

The safety factors applicable to the ultimate axial pullout capacity of pile are to be the same as those given in [2.3.3].

2.6 Lateral resistance of pile

2.6.1 General

The behaviour of the soil-pile system subjected to lateral loads is to be analysed on the basis of realistic relationships which relate the deformations to the soil reactions.

Such relationships, generally represented by (p-y) (soil reaction lateral deflection) curves, are characteristic of the type of soil, pile dimensions and loading application conditions (static, cyclic or impact loads).

The (p-y) curves may be constructed using the results of laboratory tests on soil samples; the influence of scour in proximity to the sea bottom and the disturbance caused by pile installation on the soil characteristics are to be taken into account.

In the absence of criteria which are more appropriate to the individual practical cases, the (p-y) curves may be constructed according to indications given in [2.6.2], [2.6.3].

2.6.2 (p-y) curves for clay soils

a) For soft clay soils, the (p-y) curve for the layer of soil located at a depth z, in m, from the sea bottom may be represented by the broken line shown in Figure 5.1, generated by the values specified in Table 5.3.

b) For stiff clay soils (i.e. when c > 96 kPa according to ISO 19902:2007 Subclause 17.8.4), and for static loads, the same considerations in item a) above are applicable.

   Instead, for cyclic loads a sharp deterioration of soil characteristics occurs due to high deformations, which result in considerable reduction of representative lateral capacity, p_r.

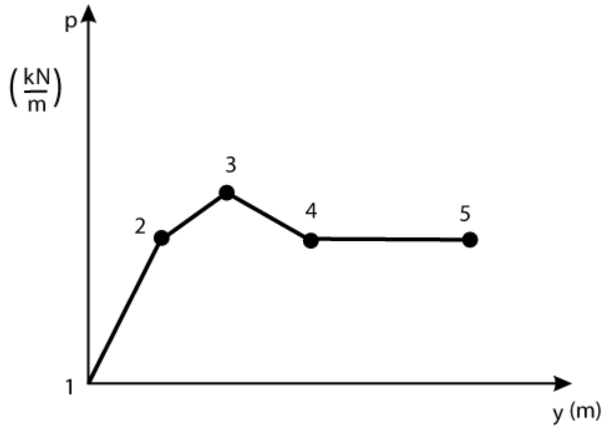


Figure 5.1 – (p-y) curve for soft clay soils.

Static load or short term action		
Point	p / p_u	**y / y_c**
1	0	0
2	0,5	1,0
3	0,72	3,0
4	1,00	8,0
5	1,00	∞
Cyclic load for $z \geq z_R$		
Point	p / p_u	y / y_c
1	0	0
2	0,5	1,0
3	0,72	3,0
4 ≡ 5	0,72	∞
Cyclic load for $z \leq z_R$		
Point	p / p_u	y / y_c
1	0	0
2	0,5	1,0
3	0,72	3,0
4	$0,72\ z / z_R$	15,0
5	$0,72\ z / z_R$	∞

Note 1:

y_c, in m, is given by the following equation:

$y_c = 2,5 \cdot \varepsilon_c \cdot D$

where:

D	:	pile diameter, in m;
ε_c	:	strain which occurs at one half the maximum stress on laboratory undrained compression tests of undisturbed soil samples;
z_R	:	depth of reduced strength zone, in m, given by the following formula: $z_R = \dfrac{6D}{\dfrac{\gamma D}{c} + J}$

where:

γ	:	effective specific gravity of soil (in water), in kN/m³;
c	:	undrained shear strength of soil, in kN/m²;
J	:	empirical coefficient, whose values are between 0,5 and 0,25 (in the absence of reliable information, 0,25 is to be used);
p_u	:	ultimate soil resistance, in kN/m (force/unit length of pile), given by the following formulae;

$$p_u = \left(\frac{6c}{z_R} \cdot z + 3c\right) \cdot D \qquad \text{for } z \le z_R$$

$$p_u = 9 \cdot D \cdot c \qquad \text{for } z > z_R$$

Table 5.3 – Coordinates of points for (p-y) curve for soft clay soils (ref. Figure 5.1).
(See also Table 17.8-1 of ISO 19902:2007)

2.6.3 (p-y) curves for sand soils

The (p-y) curve of the layer located at depth z is as shown in Figure 5.2 generated by abscissa and ordinates of the points u, m and k, which may be computed as follows:

point u:

$$\begin{cases} y_u = \dfrac{3}{80} D \quad (m) \\ p_u = A \cdot p_c \ (kN/m) \end{cases}$$

where:

D : pile diameter, in m;

A : empirical coefficient according to Figure 5.3;

p_c : to be taken equal to p_{cs} if $z \le z_t$ or equal p_{cu} if $z > z_t$, in kN/m:

$$p_{cd} = \gamma \left[\frac{k_0 z \ \tan\Phi \sin\beta}{\tan(\beta - \Phi)\cos\alpha} + \frac{\tan\beta}{\tan(\beta - \Phi)}(D + z\tan\beta \ \tan\alpha) + k_0 \ z \ \tan\beta \ (\tan\Phi\sin\beta - \tan\alpha) - k_a \ D\right]$$

$$p_{cs} = D \ \gamma \ z \ [k_a \ (\tan^8(\beta - 1) + k_0 \tan\Phi \ \tan^4\beta]$$

In any case, it could be useful consider the p_c as the minor value between p_{cs} and p_{cd} in order to avoid the overestimate of the lateral resistance as defined in Subclause 17.8.6 ISO 19902:2007.

z_t : depth below soil surface to bottom, obtained when p_{cs} is equal to p_{cp}, in m;

γ : effective specific gravity of sand (in water), in kN/m³;

Φ : angle of internal friction of sand, in degrees;

α : $\frac{\Phi}{2}$, in degrees;

β : $45 + \frac{\Phi}{2}$, in degrees;

k_o : 0,4;

k_a : $tg^2\left(45 - \frac{\Phi}{2}\right) = \frac{(1 - \sin\Phi)}{(1 + \sin\Phi)}$;

point m:

$$\begin{cases} y_m = \dfrac{1}{60} D \quad (m) \\ p_m = B p_c \quad (kN/m) \end{cases}$$

being B an empirical coefficient according to Figure 5.4.

point k:

determined by the intersection of the two lines given by the equations:

$p = K \ z \ y \quad (kN/m)$

$p = C \ y^{1/n} \quad (kN/m)$

where:

K : initial modulus of subgrade reaction depending on the grade of sand density, given in Table 5.4 [(1)]:

$$C = \frac{p_m}{y_m^{1/n}}$$

$$n = \frac{p_m}{m \cdot y_m}$$

$$m = \frac{p_u - p_m}{y_u - y}$$

Therefore, the abscissa and ordinate of point k are:

$$y_k = \left(\frac{C}{K \cdot z}\right)^{\frac{n}{n-1}} \qquad (m)$$

$$p_k = K \cdot z \cdot y_k \qquad (kN/m)$$

For some combinations of the parameters involved, the K value may result in a deflection y_k greater than y_m, in which case the parabolic portion of the (p-y) curve is to be omitted.

Note:

(1) The initial modulus of subgrade reaction represent the soil in the Winkler method. It consider the soil as equivalent spring and K represent the stiffness of the spring.

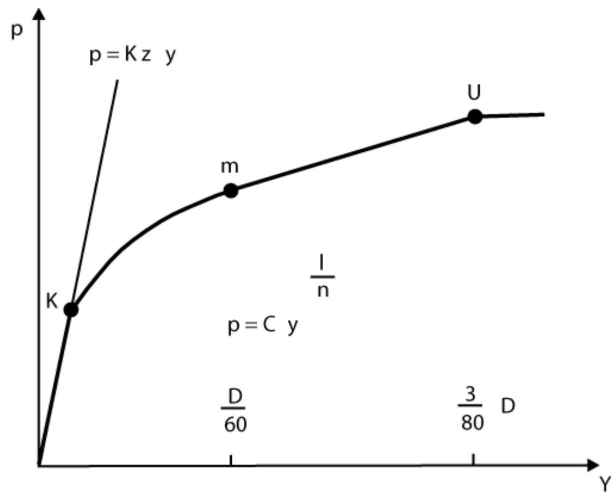


Figure 5.2 – (p-y) curve for sand soils.

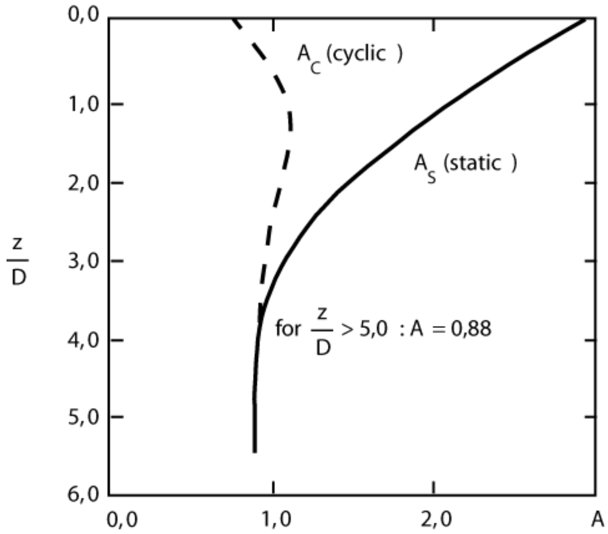


Figure 5.3 – Empirical coefficient A as a function of z/D.

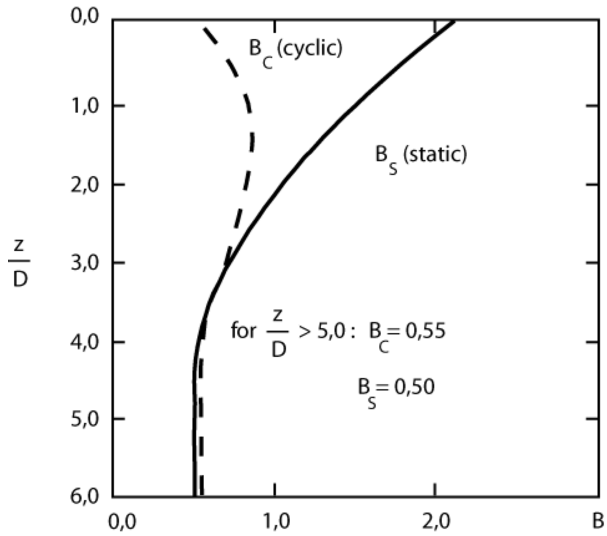


Figure 5.4 – Empirical coefficient B as a function of z/D.

DENSITY	K (kN/m^3)
loose	5400
medium	16300
dense	33900

Table 5.4 – Initial modulus of subgrade reaction as a function of grade of sand density.

2.7 Group effects

The axial and lateral bearing capacity of a group of piles depends on several factors such as pile characteristics, type and strength of soil, sequence of soil layers, pile installation method, etc..

The knowledge on this subject is rather limited and therefore the strength calculation of the group is to be carried out on the basis of conservative assumptions, due consideration being given to the possibility that the actual spacing of piles is less than that assumed for the design due to a non-perfect installation.

First of all the group effects have to be considered where piles spacing are less than eight diameters.

Where more reliable data are not available, the following considerations are applicable:

a) the end bearing capacity of the group in homogeneous soils may be taken equal to the sum of the single pile contributions;

b) the skin friction capacity of the pile group is to be taken equal to the sum of the single pile contributions multiplied by a reduction factor R, given by the following formula:

$$R = \frac{p}{\sum_{i}^{N} \pi \cdot D_i}$$

p : external perimeter of the group, in m;

D_i : diameter of the i-pile, in m;

N : number of the piles.

Such a reduction is required in any case for sandy soils, while it may be neglected for clay soils when the ratio of the minimum spacing of piles to the pile diameter exceeds the value 0,785 ($N^{0,5}$ + 1).

If R > 1, is to be assumed R = 1.

2.8 Pipe wall thickness

a) The D/t ratio of pile diameter to thickness is to be such as to preclude the possibility of occurrence of local buckling during the installation operations and the operation life of the foundation.

For guidance, it can be specified that the D/t ratio for piles driven in high strength soils is to comply with the following formula:

$$t \geq 6,35 + \frac{D}{100}$$

where:

D : pile diameter, in mm;

t : pile wall thickness, in mm.

b) In general, the pile wall thickness is not constant for the entire length of the pile, but varies with the anticipated stress level, which is normally highest in the portion close to the sea bed. It is recommended that the heavy wall thickness of the pile is extended for a reasonable length to take account of the two possibilities of not achieving the foreseen penetration or of being compelled to exceed it in order to reach a layer with high bearing capacity.

c) It is recommended that the end of the pile is provided with a driving shoe having a thickness increased by 50% in respect of that mentioned in item a) above.

Other detailed information on pipe wall requirements are described in the Subclause 17.10 of ISO 19902:2007.

2.9 Bonding between pile and structure

2.9.1 Platform loads are generally transferred to foundation piles by filling the annulus between the pile and relevant housing in the structure by cement grout in such a way that the axial load transferred by the structure to the pile is transferred through the bond action between the pile surface and the cement grout.

Instead, the lateral force results in a compression of the cement grout annulus whose effect is generally negligible.

2.9.2 The bonding action between pile and cement grout (and between cement grout and pile housing) is affected by several factors, such as:

a) type of cement grout (cement, water, additives, etc.);

b) temperature;

c) method of installation;

d) movements of platform while the cement grout is setting.

2.9.3 For general provisions relevant to the strength and the fatigue resistance of grouted connections reference can be made to Clause 15 of ISO 19902:2007.

Where mechanical devices are provided to avoid the pile axial load being transferred by friction between steel and cement grout only, for instance by fitting welded circumferential rings between the outer surface of pile and the inner surface of its housing, it will be necessary to verify the connection taking into account the geometry realised and the compressive strength of the portion of the grout close to the rings.

3 Gravity type foundations (shallow foundations)

3.1 General requirements

Gravity type foundations are characterised by a low ratio of the maximum penetration depth to the horizontal extent of the foundation base. General consideration on the design of shallow foundations is contained in the Subclause 17.12.1 of ISO 19902:2007.

3.2 Design criteria

The acceptance criteria for all the design condition to be checked for the shallow foundations are described in the Subclause 7.3 of ISO 19901-4:2003.

Also reference can be made to Annex A of ISO 19901-4:2003.

3.3 Soil resistance

3.3.1 Unit bearing capacity

The bearing capacity of the foundation system is influenced by the following main aspects:

a) the shape of the foundation base;

b) loads acting on the foundations and their variation over time;

c) characteristics of sea bottom;

d) geophysical characteristics of the soil layers concerned;

e) possible rupture surfaces in the soil in relation to measures adopted against sliding (see Figure 5.5);

f) possible softening phenomena in the soil due to alternating loads;

g) pore pressure variation corresponding to the actual stress level of the soil.

Where conditions given in [3.5] do not occur, the unit bearing capacity may be performed by the bearing capacity formulas given in [3.3.2] and [3.3.3].

The soil develops its resistance depending on the following conditions:

- undrained conditions;
- drained conditions.

The first one above applies when loading and its variation occur so rapidly that no drainage and hence no dissipation of excess pore pressure occur.

Such type constitute the also called "short-term analysis"; it considers the angle of internal friction of the soil $\Phi = 0$ and the undrained shear strength of the soil c as essentially involved.

Where, on the contrary, the rate of loading is sufficiently slow, complete drainage occurs and excess pore pressures are not developed, the "long-term" condition is developed. The behaviour of the soil is controlled by its friction angle Φ' and by the cohesion intercept c' of the Mohr-Coulomb effective stress failure envelope.

3.3.2 Undrained conditions

Detailed practise in order to define the unit bearing capacity of the soil is given in the Subclause 7.4 and the Subclause 7.5 of ISO 19901-4:2003.

In the quite frequently encountered cases of:

- vertical centric load;
- horizontal foundation base;
- horizontal sea bed;

Formulas defined in the mentioned ISO 19901-4:2003 references may be reduced as follows:

1) for infinitely long rectangular footing, the unit bearing capacity, may be given by the simplified formula:

   $q_{d,v} = 5{,}14\ c_u$

2) for circular or square footing, the unit bearing capacity may be given by the simplified formula:

   $q_{d,v} = 6{,}17\ c_u$

Where c_u is the undrained shear strength. In order to evaluate the shear strength the Subclause 7.7 of ISO 19901-4:2003 can be used as reference.

3.3.3 Drained conditions

Detailed practise in order to define the unit bearing capacity of the soil is given in the Subclause 7.6 of ISO 19901-4:2003.

Also in this case, in the presence of soil having $c_u = 0$ (sand) and of applied centric load, simplified formulae may be used, as follows:

a) for infinitely long rectangular footing, the unit bearing capacity may be expressed by the formula:

   $q_{d,v} = 0.5\ \gamma' B\ N_\gamma$

b) for circular or square footing, the unit bearing capacity may be expressed by the formula:

   $q_{d,v} = 0.3\ \gamma' B\ N_\gamma$

   Where the parameters ',B, N are to be selected in accordance with the Subclause 7.6 of ISO 19901-4:2003.

3.3.4 Filling of voids

To ensure sufficient platform stability, filling of voids between the platform structure and the sea bed may be necessary. In such case the stresses induced by filling pressures are to be kept within acceptable limits.

The materials used for filling are to be capable of maintaining sufficient strength during the whole design life of the platform under the deteriorating effects of repeated loads, chemical action and possible defects in the placement of filling materials themselves.

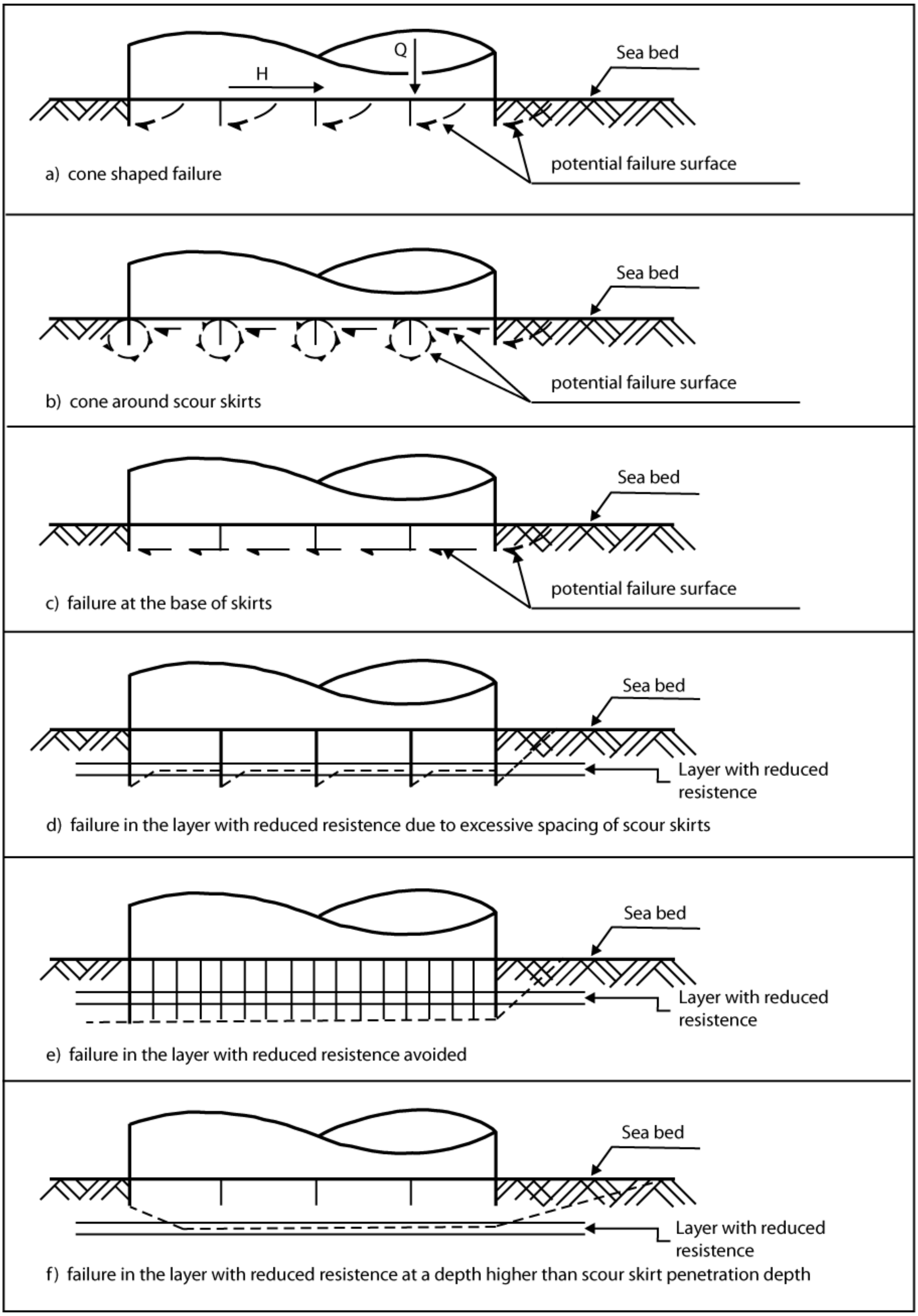


Figure 5.5 – Representation of possible soil failure mechanisms due to lateral displacement.

3.4 Settlement and displacements

The evaluation of possible short-term and long-term deformations is to be performed by recognised methods deemed appropriate by the Tasneef.

It is very important to determine such deformations for the safety both of the structural members of the platform and of the components which pass through the contact surface between the foundation base and ground (risers, etc.) or which join the sea bed to the platform itself (pipelines, etc.).

The evaluation of possible short-term and long-term deformations shall include:

a) immediate settlements;
b) consolidation settlements of the soil (long-term soil deformation);
c) soil settlements induced by cyclic actions;
d) differential settlements induced by moments, torque and eccentricity;
e) creep.

For the condition where the structure base is circular, rigid, subject to static loads or to loads which may be considered as static, and rests on isotropic and homogeneous soil, the short-term (undrained) deformations may be evaluated by the following formulae:

$$u_v = \frac{1 - \nu}{4 \cdot G \cdot R} Q$$

$$u_h = \frac{7 - 8 \cdot \nu}{32 \cdot (1 - \nu) \cdot G \cdot R} \cdot H$$

$$\vartheta_f = \frac{3 \cdot (1 - \nu)}{8 \cdot G \cdot R^3} \cdot M$$

$$\vartheta_t = \frac{3}{16 \cdot G \cdot R^3} \cdot M_t$$

where:

u_v , u_h	:	vertical and horizontal deformations, in m;
Q , H	:	vertical and horizontal loads, in kN;
ϑ_f , ϑ_t	:	overturning and torsional rotations, in rad;
M, M_t	:	bending and torsional moments, in kN m;
G	:	elastic shear modulus of the soil, in kN/m^2;
ν	:	Poisson's ratio of the soil;
R	:	radius of the base, in m.

These formulae may also be used for square base of equal area.

3.5 Limits of application of the formulae for the determination of the bearing capacity

The application of the formulae for the determination of the unit bearing capacity is subject to the following limiting conditions:

a) homogeneous, isotropic and fully plastic soil;
b) low ratios of horizontal to vertical loads;
c) low torsional stress levels;
d) regular foundation geometry;
e) presence of suitably spaced skirts so that, if lateral instability occurs, a horizontal failure plane in the soil is ensured rather than a failure at the base structure-soil interface.

Where the above conditions are not satisfied, more conservative methods of analysis and increased safety factors are to be used or more refined techniques are to be adopted, such as:

- limit analysis to determine bounds on collapse loads and relative sensitivity of collapse loads to parameters of interest;
- numerical analysis such as finite differences or finite elements;
- properly scaled model tests such as centrifuge tests.

Special consideration is also to be given to the effects of cyclic loading on pore pressures and to the possibility that soil softening may occur.

3.6 Hydraulic instability

This type of foundation failure may occur in the presence of soils which are easily subject to erosion and softening.

The risks of reduction of bearing capacity due to hydraulic gradients, with consequent seepage (i.e. constant flow of water through pores), of formation of piping channels, with consequent erosion of soil beneath the foundation, and of scour are to be considered.

To prevent erosion beneath the foundation, scour skirts may be provided penetrating through erodible layers and extending their influence up to those layers which are not subject to erosion.

In order to assess the hydraulic stability the prescriptions given in the Subclause 7.10 of ISO 19901-4:2003 shall be followed.

3.7 Dynamic behaviour

The construction of a model which satisfactorily represents the dynamic behaviour of gravity foundations, when the stress level is quite low, is generally performed by the continuous "half space" approach, which is based on the assumption of linear elastic behaviour of the soil considered as homogeneous.

In real cases of anisotropy, of layered soil with energy radiated from the footing reflected by the interfaces between the layers and, especially, of non-linearity of stiffness and damping characteristics of soil and their frequency dependence, more appropriate analyses are required.

Dynamic actions are imposed on a structure-foundation system by current, waves, ice, wind, and earthquakes. The influence of the foundation on the dynamic forces and the integrity of the foundation itself shall be considered.

3.8 Installation feasibility

3.8.1 The gravity foundations are frequently provided with scour skirts to improve stability and prevent scour and with dowels (hollow pipes of large diameter) to facilitate orienting and positioning operations.

The estimate of resistance to penetration of these devices is of great interest for the purpose of scantlings of the ballasting system, so that proper installation of the structure base on the sea bed can be ensured.

For its determination it is necessary to identify the soil layers by means of soil samples and laboratory tests and to measure by a cone penetrometer the average resistance to penetration among the values obtained by tests carried out on various soil layers.

3.8.2 The resistance to penetration R, in kN, of scour skirts is given by their end resistance and skin friction resistance, and is calculated by the following formula:

$$R = K_P(d) \cdot A_P \cdot q_c(d) + A_S \int_0^d K_f(z) \cdot q_c(z) \cdot dz$$

where:

z : depth of the soil layer under consideration, in m;

d : penetration depth, in m;

K_p : empirical coefficient relating to end resistance;

K_f : empirical coefficient relating to skin friction;

q_c : resistance to penetration measured by cone penetration, in kN/m²;

A_p : end area of scour skirt, in m²;

A_s : skin area of scour skirt per unit penetration depth, in m²/m.

The empirical coefficients K_p and K_f may be selected in Table 5.6, which are the highest expected values of the resistance to penetration.

For penetration depth lower than 1 to 1,5 m, the values shown in Table 5.6 should be reduced by 25 to 50 per cent due to local piping or lateral movements of the platform.

For situations with negligible environmental actions seeing as the Subclause 7.14 of ISO 19901-4:2003, the following criterion shall be satisfied:

$$E_v \geq R$$

Where E_v are the vertical actions due to the installation phase.

Usually the vertical action can be evaluated as the percentage of weight in water of the gravity foundation interesting the scour skirt.

The installation criteria given in the Subclause 7.14 of ISO 19901-4:2003 shall be considered.

Type of soil	K_p	K_f
Clay	0,6	0,05
Sand	0,6	0,003

Table 5.6 – Empirical coefficients K_p and K_f.

PART B CHAPTER 6

ASSESSMENT OF EXISTING STRUCTURES

1 General

1.1 General

1.1.1 This Chapter provides general requirements and procedures for the assessment of existing fixed steel platforms, applicable to both substructures and topsides structures.

1.1.2 Specific requirements for the structural assessment of existing fixed offshore platforms are reported in ISO 19902:2007, Clause 24, to be used as part of the general SIM (Structural Integrity Management) process described in ISO 19902:2007, Clause 23 and shown in its Figure 24.2-1.

1.1.3 When an initiator out of those defined in Part B, Chapter 1, [4.1.1] is triggered, the reassessment process of the structure of an offshore platform is to be carried out following the different steps described in Section 2.

2 Assessment process

2.1 Assessment data gathering

2.1.1 In order to perform the engineering reassessment of an existing platform, sufficient information should be collected by the Owner or by the assessment Designer at the beginning of the renewal process, with reference to the original design data and the actual status of the platform.

2.1.2 Quality data is essential for the assessment. For modern platforms, such data usually exists. For old platforms, data are usually limited and should be augmented with field measurements, if not already available. In all cases it is essential to have a current inventory of the platform structure.

2.1.3 The following is a summary of data that should be available and may be required according to the standard reassessment procedure:

a) General Information:

- Date of installation;
- Original and current platform use and function;
- Location, water depth and orientation;
- Platform structural type;
- Number of wells, risers and potential pollution rate;
- Manning level;
- Other site specific information.

b) Original Design Data:

- Design drawings and material specifications;
- Design code (according to which the platform was designed) and design utilisation ratio of the structural components);
- Environmental data (storm and operating wind, wave and current, long term wave distribution and earthquake if applicable);
- Deck clearance elevation;
- Deck loads and equipment arrangement;
- Soil and foundation data;
- Number, size and design penetration of piles and conductors;
- Appurtenances list and location as designed.

c) Construction and Fabrication Data:

- As-built drawings;
- Fabrication, welding and construction specifications;
- Pile and conductor driving records and pile grouting records, if applicable.

d) Platform History Data:

- Environmental loading history and performance of the platform during past extreme environmental events;
- Operational loading history (happened collision and accidental events and possible damages reported);
- Survey and maintenance records;
- Repairs description: analyses, drawings and dates;
- Modifications description: analyses, drawings and dates.

2.2 Inspection on the current platform status

2.2.1 General requirements

In order to integrate and to complete the data information required and collected according to [2.1.3], the present condition of the platform has to be defined with specific field inspections and on-site measurements which are to be performed by field surveyor before starting the engineering assessment; the on-field topside inspection campaign is aimed to particularly determine:

- Deck actual size, location and elevation;
- Deck existing loading and equipment arrangement;
- Field measured deck clearance elevation;

- Wells-number, size and location of existing conductors,

while an underwater survey is to be carried out to appropriately cover:

- General visual inspection (GVI) of the jacket;
- Close visual inspection (CVI) and non-destructive examination (NDE) of a selected (limited) number of nodes (such a limited NDE inspected sample should be in principle selected in relation to available and expected fatigue performance and joints criticality);
- Wall thickness measurements (WTM) of several members;
- Corrosion protection measurements (CPM);
- Marine growth measurements (MGM).

Specific requirements for the underwater survey are reported in the following [2.2.2].

The Owner or the assessment Designer is to define and propose the appropriate survey level according to [2.2.2] and to support the proposal with adequate engineering justifications to demonstrate the fitness for purpose. The selection is to be submitted to Tasneef for review and approval.

2.2.2 Requirements for submarine survey

In order to verify the actual status of the submerged structural parts of the platform, as a minimum, a Level II Survey according to API RP 2A (Recommended Practice for Steel Fixed Offshore Platforms, 21st Ed.) as described in [2.2.4] below is required, in addition to the Level I Survey (see [2.2.3]), which should be anyway carried out for verifications in the splash zone and corrosion protection assessment.

Following to the Level II Survey, based on relevant engineering judgement, additional campaign can be required to carry out Level III/Level IV Surveys (see [2.2.5] and [2.2.6] respectively) according to problems highlighted in previous phase survey, such as damages due to ship collisions or abnormal environmental events, fatigue or corrosion degrade, lack of structural members and connections, etc..

2.2.3 Level I Survey

A Level I survey consists of a below-water verification of performance of the cathodic protection system (for example, dropped cell), and of an above-water visual survey to determine the effectiveness of the corrosion protection system employed, and to detect deteriorating coating systems, excessive corrosion, and bent, missing, or damaged members.

This survey should identify indications of obvious overloading, design deficiencies, and any use that is inconsistent with the platform original purpose. This survey should also include a general examination of all structural members in the splash zone and above water, concentrating on the condition of the more critical areas such as deck legs, girders, trusses, etc..

If above-water damage is detected, non-destructive testing should be used when visual inspection cannot fully determine the extent of damage. Should the Level I survey indicate that underwater damage could have occurred, a Level II inspection should be conducted as soon as conditions permit.

2.2.4 Level II Survey

A Level II survey consists of general underwater visual inspection by divers or ROV to detect the presence of any or all of the following:

- Excessive corrosion;
- Accidental or environmental overloading;
- Scour, seafloor instability, etc.;
- Fatigue damage detectable in a visual swim-around survey;
- Design or construction deficiencies;
- Presence of debris;
- Excessive marine growth.

The survey should include the measurement of cathodic potentials of pre-selected critical areas using divers or ROV.

Detection of significant structural damage during a Level II survey should become the basis for initiation of a Level III survey. The Level III survey, if required, should be conducted as soon as conditions permit.

2.2.5 Level III Survey

A Level III survey consists of an underwater visual inspection of preselected areas and/or, based on results of the Level II survey, areas of known or suspected damage. Such areas should be sufficiently cleaned of marine growth to permit thorough inspection. Preselection of areas to be surveyed should be based on an engineering evaluation of areas particularly susceptible to structural damage, or to areas where repeated inspections are desirable in order to monitor their integrity over time.

Flooded member detection (FMD) can provide an acceptable alternative to close visual inspection (Level III) of preselected areas. Engineering judgment should be used to determine optimum use of FMD and/or close visual inspection of joints. Close visual inspection of pre-selected areas for corrosion monitoring should be included as part of the Level III survey.

Detection of significant structural damage during a Level III survey should become the basis for initiation of a Level IV survey in those instances where visual inspection alone cannot determine the extent of damage. The Level IV survey, if required, should be conducted as soon as conditions permit.

2.2.6 Level IV Survey

A Level IV survey consists of underwater nondestructive testing of preselected areas and/or, based on results of the Level III survey, areas of known or suspected damage. A Level IV survey should also include detailed inspection and measurement of damaged areas.

A Level III and/or Level IV survey of fatigue-sensitive joints and/or areas susceptible to cracking is necessary to determine if damage has occurred.

If crack indications are reported, they are to be assessed with respect to expected residual life and structural integrity aspects of the platform. Monitoring fatigue-sensitive joints, and/or reported crack-like indications, can be an acceptable alternative to analytical verification.

2.2.7 Survey Specification

The assessment Designer is to prepare a Survey Specification containing the detailed scope of survey.

Survey Specification is to cover as a minimum, but not necessarily limited to, the following aspects:

a) Survey design:
- Referenced design documents, codes and standards;
- Criteria of selection of the elements to be inspected (e.g. structural criticality, fatigue, significance for safety);
- General criteria for evaluating the survey results.

b) Inspection and testing extension:
- Number, location and identification of the elements to be inspected for each type (e,g, nodes, welded joints, structural elements, anodes);
- Methods and techniques to be used for the inspections of the selected elements (GVI, CVI, NDE, WTM, CPM, MGM etc);

c) Inspection methods and techniques:
- Listing of the approved methods and techniques;
- Application limits for each method and technique;
- Required range of measures, accuracy of readings, statistical reliability;
- Inspection personnel minimum qualifications;
- Any specific limitation of use.

d) Information and data to be recorded and reported:
- GVI, CVI, NDE, WTM, CPM, MGM inspection and testing results;
- Sketches, drawings, graphs;
- Photographic and Video recording;
- Any necessary data elaboration.

The Survey Specification is to be issued to Tasneef for review and approval.

2.2.8 Survey Procedure

The assessment Designer or the contractor assigned to perform the survey is to prepare a Survey Procedure in line with the above described Survey Specification and containing the detailed survey procedures.

Survey Procedure is to cover as a minimum, but not necessarily limited to, the following aspects:

a) Referenced documents:
- Survey Specification;
- Any additional code and standards utilised for the survey execution;
- Local regulations;
- Safety regulations.

b) Survey planning and schedule as applicable

c) Inspection methods and techniques:
- Technique;
- Equipment type;
- Operators qualifications;
- Calibration;
- Execution;
- Reporting.

d) Any proposed advanced techniques (type, qualifications, records of previous successful projects) (e.g. ACFM, Guided waves, MTM);

e) Inspection and Test Plan including inspection points for the assigned parties (including Tasneef);

f) Index, format and forms of the survey report;

The Survey Procedure is to be approved by the assessment Designer and issued to Tasneef for review and approval.

2.3 Definition of the up-to-date platform model

2.3.1 An updated structural model representing the present status of the platform is to be built, following to the previously performed assessment steps carried out, with geometric and material data considering inspection results, damages and each modification occurred with respect to the original design.

2.4 Definition of the loads

2.4.1 Extreme and operational loads on the structure are to be defined in accordance with the recognised standard methods given the data collected with reference to dead, live and environmental loads.

2.4.2 The current methods of environmental actions calculations described in these Rules, see Chapter 3, should be used. However, different methods of action calculation may be used if they can be demonstrated to represent the load more realistically.

2.4.3 The data upon which predictions of environmental extremes made at design stage might no longer be appropriate. The data are to be analysed to determine whether the original estimates of environmental extremes are still valid. Updated data can be obtained from:

- Measurements at the site;
- Measurements at nearby sites;
- Hindcast studies.

2.5 Verification of the platform structure

2.5.1 Strength assessment

Upon completion of the updated structural model based on structure present conditions as well as future intended conditions the verification of the structural safety is to be performed according to Clauses 12 to 15 of ISO 19902:2007; in particular, the structural members are to comply with the requirements of Clause 13 and the structural connections are to comply with the requirements of Clauses 14 and 15 with the exceptions of Subclause 24.9.2.2.2.

In the strength assessment of existing platforms it is permissible to have limited individual component failures provided that the reserve against overall system failure remains acceptable, that means that the strength assessment may be carried out by performing the non-linear ultimate strength procedure specified in ISO 19902:2007, Subclause 24.9.3.

Also an ultimate global strength assessment might be reported when it is not possible to show that the structure is acceptable by analysis, repairs or strengthening. In fact, when strengthening is not a viable option, decreased reliability of the overall system could be acceptable, provided that the consequences of failure are acceptable for both the life and the environment, e.g. de-manning the platform to prevent loss of life and installation of safety devices to maximise hydrocarbon containment.

2.5.2 Fatigue assessment

In the assessment of existing structures a special emphasis should be put on the fatigue analysis, with due consideration given to the accumulated degradation effects and to the future accumulation of the fatigue damage during the foreseen extension life.

The results of the inspections carried out during the past service of the platforms are to be used to demonstrate appropriate future fatigue reliability.

The fatigue analysis inside a reassessment process should be performed on a probabilistic basis. Fatigue is a process dominated by uncertainties of many kinds, generally of random nature. For this reason, in order to attain a low risk of failure, the design code requirements are usually very conservative and provide, on the average, a high safety margin. The conventional fatigue analysis carried out on old platforms for a life extension would not in many cases meet current code requirements. Probabilistic analysis can give the most exhaustive assessment of criticality to fatigue failure and also provide the appropriate tool for giving consideration to both the reliability of inspection results and crack growth behaviour, as required by ISO 19902:2007, Subclause 24.9.2.2.3.

If a spectral fatigue approach is undertaken, a prediction model of the structural dynamics as close as possible to the real response is of paramount importance since the fatigue spectral analysis is driven by the vibration analysis results.

In order to calibrate the calculated dynamic response (in terms of natural periods and modal shapes of the structures) as close as possible to the actual jacket response, a structural monitoring system such as outlined in Part B, Chapter 1, [2.4.2] to have accelerations continuously recorded on field is strongly recommended by relevant monitoring devices.

According to the results of the fatigue assessment an inspection plan is to be prepared with appropriate scheduling to ensure the maintenance of the required structural reliability through the different platform components.

In general, future inspection requirements are to comply with the provisions of ISO 19902:2007, Clause 23.

2.5.3 System assessment

As outlined in [2.5.1], for the purpose of reassessment and extension of design life of an existing platform a system analysis may be performed to verify that the whole system is able to withstand given extreme environmental loads with an acceptable risk level, even if some structural components will reach the failure status.

A system assessment procedure may be carried out through different verification steps, whose level of computational complexity is increasing by increasing the level from a) to c) as follows:

a) <u>Linear elastic analysis of structural redundancy</u>, where the structural components not verified under the design loading conditions are removed from the model and relevant loads are supported by remaining structural elements; the analysis is repeated until all remaining structural components are verified or it is proved that the structure is not able to withstand the design loads;

b) <u>Ultimate strength analysis by elasto-plastic analysis</u>. The structural model is subject to environmental loads which increase up to the whole system collapse. The verification can be considered satisfied when the collapse load will result "appropriately" greater than the design load (typically, the 100-yrs environmental loads).

c) <u>System reliability analysis</u>. The elasto-plastic analysis carried out as per Level b) has to be integrated by a statistical evaluation of both the strength and the environmental load, in order to finally evaluate the yearly probability of collapse in storm conditions.

The reported Level b) may be carried out by evaluating the resistance capacity of the platform, R_d (in as-is conditions), under storm load conditions coming from given headings, by means of execution of non-linear push-over runs. In the quasi-static non-linear push-over analysis, loads are applied in sequence. Dead and live loads are to be applied to their nominal value, while the 100-year environmental load vector (which includes wave, current and wind loads) is to be applied and increased until the structural collapse of the whole platform. This evaluation is to be carried out for each environmental heading identified in the in-place analysis.

The RSR parameter i.e. the ratio between the mean base shear resistance capacity, R_d, and the design load F_{100} is evaluated:

$$RSR = \frac{R_d}{F_{100}} \qquad (1)$$

and compared to a minimum acceptable target value, RSR_{lim} of the same RSR parameter. The structure can be generally considered fit for purpose if the calculated RSR is greater than the prescribed RSR_{lim}.

In case that this condition is not fulfilled, i.e. the push-over analysis shows an inadequate structural system capacity the elasto-plastic analysis carried out has to be integrated by a statistical evaluation of both the strength and the environmental load, in order to finally evaluate the yearly probability of collapse in storm conditions.

2.5.4 Reference value for the Reserve Strength Ratio

Target values for the parameter RSR are often discussed in available state of the art and literature in relation to the maximum acceptable value of yearly probability of failure for the whole structure.

For existing offshore platforms, according to ISO 19902:2007, Subclause 24.5.1, appropriate acceptance criteria are to be set on the basis of the exposure category of the platform (see Part B, Chapter 1, [1.2]).

Just as reference, ISO 19902:2007 provides in its Annex A.9.9.3.3 notional limit values for the yearly probability of failure P_c (and corresponding RSR) as shown in Table 6.1, to be considered for new structures in various regions of the world, as a function of the risk exposure category:

	High Risk Class $P_c = 3x10^{-5}$ (e.g. fully manned)	Low Risk Class $P_c = 5x10^{-4}$ (e.g. not manned)
Region	**RSR**	
Australia	2.18	1.60
North Sea	1.92	1.49
Gulf of Mexico	*Not reported*	1.60

Table 6.1 – Reference notional values for RSR

For existing platforms, it is reported that “the criteria could be less severe, provided that the risk is maintained as low as reasonably practicable”.

RULES FOR THE CLASSIFICATION OF STEEL FIXED OFFSHORE PLATFORMS

Part C

Chapters **1 2**

PART C CHAPTER 1

GENERAL REQUIREMENTS

1 General

1.1 Application

1.1.1 The requirements of this Section apply to the systems intended to process liquid or gaseous hydrocarbons from the completed wells or from loading arrangements (loading arms or hoses). These systems include separation, treating and processing systems as well as systems intended for supporting the hydrocarbon production and process such as power supply, hydraulic system, utility/instrument air system, produced gas as fuel system, fuel oil system etc.).

1.2 Production and process boundaries

1.2.1 The main boundaries of the production and process systems are:

- any part of the production and process system located on the platform;
- process control systems;
- the shutdown valve at the export outlet from the production or process plant to the export system.
- the outlet from hydrocarbon flare and vent system

1.3 Basic process design principles

1.3.1 The following information are to be provided as basic design data and principles which underlie the application and relevant classification or certification of process, production and safety arrangements in a typical fixed platform design and maintenance:

- Safety and operating philosophy;
- Environmental conditions;
- Design pressure and temperature;
- Process design principles;
- Basic design consideration (for the principal causes of overpressure);
- Special consideration (e.g. local codes, national, state and local governmental regulation and lows).
- Plant Arrangement (battery limit definition);
- Wellhead and Separation System;
- Pressure containing equipment and storage vessels;
- Gas Treatment and Compression System;
- Water Injection, Gas Injection and Gas Lift System;
- Heating and Cooling Systems;
- Insulation;
- Chemical Injection Systems;
- Drainage Systems;
- Electrical, instrumentation and control system with provision of additional instrumentation;
- Flare system (capacity and sizing);
- Vents and drains;
- Managing Control of Hazard in process, storage and transportation (flammable gas, toxic gas and fire detection system);
- Blast protection and fireproofing (Minimizing damage for fire, explosion or accident; fire-fighting facilities);
- Special consideration (e.g. for local codes or large inventory of hydrocarbons),
- Shutdown system and safe start-up/shut-down procedures and facilities that should be available to permit plants or individual items of equipment to be safely started up and shut down (e.g. purge connection, drainage system etc.);
- Emergency de-pressuring system;
- Shutdown devices (PRV, RD, Check Valve, EBV) and relevant failure modes;
- Corrosion control system;
- General requirements for valves;
- Wellhead control system;
- Subsea control system;
- Pig Launchers and Receivers;
- Hydrocarbon Export Pump Systems;
- Hydrocarbon Offloading/Export System (for Floating Installations)
- Miscellaneous items such as instrument air, process nitrogen system, etc.,

Further aspects may depend on the actual offshore platform under consideration.

1.4 Documentation to be submitted for topside process

1.4.1 The documentation to be submitted to Tasneef for the topside process is depending on the scope of work agreed for certification or classification.

1.4.2 Independently of the specific scope of work identified for the process plant, appropriate documentation should be provided to cover the following information:

- description of the safety and environmental philosophy;
- safety case (i.e. risk assessment and management) of the installation;
- description of the design process for the production operations and systems;
- description of the operating philosophy,

1.4.3 For process plant topside classification, Table 1 lists the plans, information, analysis, etc. which are to be submitted for productions systems and arrangements, in addition to the information required in other Parts of Tasneef Rules, as applicable, for e.g.

- Lifesaving appliances;
- Emergency response system (EER installations, equipment and arrangements);
- Plans of the components of the shuttle's mooring system and of any other auxiliary mooring systems.

1.4.4 For the purpose of classification, documentation relevant to accommodations and living quarters is to include what required for showing compliance with the national legislation in force.

1.4.5 Information listed in Tab 2 are also to be submitted.

Table 1 : Documents to be submitted for topside process production systems and arrangement

A/I **(1)**	Documents
I	Characteristics of hydrocarbons to be processed.
I	Process description and operating philosophy
I	Main layout drawings
A	Well completion system arrangement
A	Process system arrangement including flaring and hydrocarbon storage
A	Relevant documentation for the evaluation of hazardous areas and associated ventilation, fire protection and emergency control
A	Drainage system
A	Piping and Instrumentation Diagrams
I	Process flow diagrams including heat and mass balances as applicable
I	Applicable calculations including capacity, temperature and pressure calculations
I	Heat radiation and dispersion calculations
I	Activation logic for depressurising system
I	Design codes and dimensional standards for the production, process and support piping systems
I	Line list, piping specification and isometric drawings.
A	For piping in Category I see [1.7.3] the following documentation is to be submitted for approval: - materials to be applied for pipes, hoses, fittings, branches, unions, plugs, flanges, bolts, nuts, gaskets, etc.; - materials to be applied for valve bodies, bonnets, stems, seat seals, springs, actuators, etc.; - corrosion allowances; - wall thickness listed for each applicable line size; - rating and type of flanges, valves, fittings, branches, unions, and type of gaskets, etc.;

	- drawings and / or certified proof test reports for non-standard piping components. - pressure test plan.
I	For piping in Category I see [1.7.3] the following documentation is to be submitted for information: - design pressure and pressure rating; - fabrication specifications including pipe bending, welding, heat treatment, type and extent of NDE, testing etc.; - flow sheets of piping and instrumentation diagrams (P&ID) with reference to appropriate designation; - flexibility analysis for the selected critical piping (to be agreed with Tasneef); - stress calculation for non-standard piping components; - hook-up plan.
I	Technical data sheets for major process vessels heat exchangers
I	Mechanical drawings for major process vessels and heat exchangers
A	Technical data sheets for process control valves (Material, type, rating and size of the valves and accessories)
I	Process shutdown system philosophy
I	Injection shutdown system philosophy
A	Process emergency shutdown system design (ESD) including cause and effects charts.
A	Injection shutdown system design
I	Safety case documentation.
A	Diagram of pressure relief and depressurization vent systems showing arrangements sizing of the lines, capacities of the relief valve, materials, design capacity, calculations for the relief valves, knock out drums, anticipated noise levels and gas dispersion analyses.
I	Operating manual of the process system including vendor manuals.
A	Constructional drawings of flares, including pilots, igniters and water seal and design calculations, including stability and radiant heat analyses.
I	Precommissioning and commissioning procedures.
I	Mothballing procedures for short and long term plant shutdown.
I	Inspection plan for each static item (e.g. RBI or similar procedure) and maintenance plan for rotating machines.
I	Process compressors and pumps data sheets.

1.5 Ambient conditions

1.5.1 Production and process systems and relevant support systems are to be designed to operate properly under the ambient conditions specified as follows:

Table 2: Ambient conditions

AIR TEMPERATURE	
Location, arrangement	Temperature range (°C)
In enclosed spaces	between 0 and +45 **(1)**
On machinery components, boilers In spaces subject to higher or lower temperatures	According to specific local conditions
On exposed decks	between -25 and +45 **(2)**
WATER TEMPERATURE	
Coolant	Temperature (°C)
Sea water or, if applicable, sea water at charge air coolant inlet	up to +32
(1) Electronic appliances are to be designed for an air temperature up to 55°C (for electronic appliances see also Chapter 2). (2) Different temperatures may be accepted by Tasneef in the case of units intended for restricted service.	

1.5.2 Tasneef may permit deviations from temperatures given in Table 2, taking into consideration the type, size and service conditions of the platform.

1.6 Topside Equipment and Components Mechanical Design

1.6.1 Minimum requirements concerning design, materials, fabrication, installation and testing for the production and utility systems and equipment with respect to their strength and performance are to be reported in the platform topside design basis document, aimed to provide appropriate safety against loss of human life, considerable physical damage or unacceptable environmental pollution.

1.6.2 The technical requirements are to be based on internationally recognized codes and standards as referred to, and are to be approved by Tasneef.

1.6.3 Mixing of codes or standards for a system or item of equipment is, in general, to be avoided.

Where a code or standard cannot be used in its entirety, selection from the recommendations in two or more codes or standards may be made but only after proper consideration of the derivation and structure of the documents, and only if safety and sound engineering practice can be maintained. Such selective application of a code or standard is to be agreed with Tasneef.

1.7 Certification of topside materials and equipment (components)

1.7.1 Equipment and components to be part of the platform are to be in accordance with the requirements of these Rules and / or internationally recognized codes and standards (see [1.6]).

1.7.2 Equipment (components) are to be divided into categories in accordance with the importance of the particular product with respect to safety of the installation, or part thereof.

1.7.3 As general guideline, equipment (components) can be categorized as follows:

- **Category I Equipment:**
  Equipment related to safety for which Tasneef requires type approval. Such equipment is to be supplied with appropriate type approval certificate and product approval certificate issued by Tasneef, or by an internationally recognized classification society (such as member or associate of IACS).
  For type approval definition and requirements reference is to be made to applicable requirements of Tasneef Rules for Testing and

Certification of Marine Materials and Equipment.

- **Category II equipment**
  Equipment related to safety for which Tasneef requires work's certificate issued by the manufacturer.
- **Non-categorized equipment**
  Equipment having minor importance for safety. No specific certification is required but proper test reports are to be available to enable correct identification and use of this equipment.

1.7.4 In principle, equipment are to be certified consistent with their function and importance for safety.

For Category I equipment the following approval procedure is to be followed:

a) Design approval, followed by type testing and type approval certificate (see also sect. 3.4.2).
b) Survey at the premises of the manufacturer, followed by issuance of a product certificate.

Depending on the extent of the survey required by Tasneef, Category I equipment can further be subdivided into *Category IA equipment* and *Category IB equipment*, with the following requirements: for Category IA equipment the survey during fabrication (task b) above) is required by Tasneef (or by the recognized third party releasing the type approval certificate), while for Category IB the same task can be considered completed by the review of the fabrication records.

1.7.5 In any case, for Category I equipment, relevant certificates issued by Tasneef (or by an internationally recognized classification society, which will be accepted as an equivalent to appropriate Tasneef's certificates) is to be supplied following to the completion of the survey during fabrication, by functional testing witnessing, pressure and load tests, as applicable.

Testing procedures are to be developed by the manufacturer according to recognized national or international standards, which are to be approved by the organization which is to issue the certificates, if requested.

et;

1.7.6 [illegible] certificate is to contain the following data as a minimum:

- Equipment specification or data sheet of the equipment;
- Statement from the manufacturer which confirms that the equipment has been constructed and manufactured according to recognized methods, codes and standards.
- Independent test certificate / report for the equipment or approval certificate for manufacturing system is also acceptable.

1.7.7 Guidance for categorization of the equipment is given in Tables 3 to 7. The Contractor shall duly in advance submit to Tasneef for approval a list of the equipment with a proposal for their categorization.

Table 3 - Categories for pressure containing equipment and storage vessels

	Conditions	Category I(1)	Category II
PRESSURE	$1 < P \le \frac{20000}{D_i + 1000}$		X
	$P > \frac{20000}{D_i + 1000}$	X	
	Vacuum / External pressure	X	
MEDIUM	Steam		
	Toxic fluids	X	
	Thermal oil	X	
	Liquids with flash point below 100 [°C]	X	
	Flammable fluids with T>150 [°C]	X	
	Other fluids with T>220 [°C]	X	
	Compressed air /gas PV≥1,5	X	
MATERIAL	σ_Y>345 [MPa] (50000 [psi]) or σ_t>515 [MPa] (75000 [psi])	X	
	Where impact testing is required	X	

Notes:

(1) Normally Category IA equipment, however, limited survey may be agreed with Tasneef based on manufacturer's Quality Assurance / Quality Control System and fabrication methods.

Symbols:

P - internal design pressure [bar]
D_i - inside diameter [mm]
V - volume [m^3]
T - design temperature [°C]
σ_Y - specified yield strength [MPa]
σ_t - specified ultimate tensile strength [MPa]

Table 4 - Categories for components in piping

Item	Conditions	Category IB (1)	Category II
PIPING SPOOLS	Wall thickness > 25,4 [mm] (1 [inch])	X	
	Design temperature > 400 [°C]	X	
	Longitudinally welded pipes for flammable / toxic fluids	X	
	Longitudinally welded pipes for non-flammable / non-toxic fluids		X
FLANGES AND COUPLINGS1)	Standard type		X
	Non-standard type flanges and coupling for flammable / toxic fluids	X	
VALVES (2)	Valves body of welded construction with ANSI rating > 600 lbs	X	
	Valves designed and manufactured in accordance with recognized standards		X
SAFETY VALVES AND RUPTURE DISCS	All	X	
EXPANSION JOINTS	For flammable or toxic fluids	X	
FLEXIBLE HOSES	For flammable or toxic fluids	X	
SWIVELS	All	X	
COMPONENTS ABOVE WHEN MADE OF HIGH STRENGTH MATERIAL	Specified yield strength > 345 [MPa] (50000 [psi]) or tensile strength > 515 [MPa] (75000 [psi])	X	

Notes:

(1) The extent for witnessing tests may be agreed with the Register based on manufacturer's Quality Assurance / Quality Control System

(2) Applicable only for piping components in systems with those media referred to in Table 3

Table 5 - Equipment category for machinery

Component	Conditions	Category IA	Category IB	Category II
PUMPS	Non-standard design and construction	X		
	High pressure or high capacity pumps, e.g. loadout, boosting, injection		X	
	Fire water pumps		X	
	Other pumps			X
AIR COMPRESSORS	Non-standard design and construction	X		
	Other air compressors			X
GAS COMPRESSORS	All		X	
GAS TURBINES	All		X	
COMBUSTION ENGINES	Non-standard design and construction	X		
	Capacity > 500 [kW]		X	
	50 [kW] < capacity < 500 [kW]			X
GEARS	See Note (1) below		X	X
COUPLINGS	All			X

Notes:

(1) Category for gears is to be either IB or II depending on the category of the prime mover from which the power is transmitted

Table 6 - Equipment category for fire protection equipment

Category	Fire protection equipment
IB	Fire dampers (1)
	Gas bottles
	Pressurised components in fire extinguishing systems
II	Fire hose
	Hose reels and associated equipment
	Nozzles
	Equipment for fixed firefighting installations (except as required for IB)
	Fire resisting divisions / materials
	Doors
	Windows
	Fire and gas detectors
	Wheeled and portable extinguishing system

Notes:

(1) Functional test may be carried out after installation.

PART C CHAPTER 2

PRODUCTION, PROCESS AND ANCILLARY PIPING SYSTEMS

1 General

1.1 General criteria

1.1.1 The design and manufacturing of production, process and ancillary piping systems are to be in accordance with a recognized Standard and with the requirements of this section. The standards are to be adhered to in their entirety.

The adopted standards are to be listed in a basic document reporting relevant design criteria, to be subject to the approval by Tasneef according to the required classification or certification purpose.

1.1.2 The plant piping systems are to be divided into segments. Each segment is to be segregated by shutdown valves that are operated from the shutdown system. The valves are to segregate production systems based on consideration of plant layout, fire zones, depressurizing system and pressure ratings.

1.1.3 A single failure of ancillary systems which are essential to the operation of the production and process system has not to cause unacceptable consequences on operating condition.

1.1.4 Piping of ancillary systems are to be in general independent of piping systems essential to the safety of the unit.

1.1.5 Piping systems for substances which present a hazard due to a reaction when mixed are to be independent of each other.

1.1.6 Suitable protection against fire, mechanical damage, erosion and corrosion is to be provided for the production and process piping system.

1.1.7 The production piping systems are to be fitted with sufficient drain and vent pots to enable draining and depressurizing of all segments in a controlled manner. They are to be permanently or temporarily connected to the flare, venting and drain disposal systems.

2 Basic requirements

2.1 Arrangement

2.1.1 In general all equipment associated with the processing and production of hydrocarbons are to be located above the main process decks.

2.1.2 The risk to personnel from potential hazards is to be minimized. In this respect the most hazardous areas of the process plant are to be located as far as possible and duly separated from the accommodation area.

2.1.3 Most hazardous process areas are those where the hydrocarbons being handled are at their highest pressure and possibly in their most volatile condition.

2.1.4 The piping used within the process areas is to be kept to a minimum and all piping is to be adequately protected from hazards such as fire, environmental exposure, dropped objects etc. that are to be described in the safety case.

2.1.5 All elements of the production plant are to be suitable for the overall design loads and are to be designed for the most onerous load combination.

They are to be designed and constructed with sufficient integrity to enable safe operation during all foreseeable conditions.

2.1.6 A single malfunction within a process system has not to lead to hazardous conditions for personnel or the unit or installation.

2.1.7 Facilities for safe isolation are to be provided for all elements of the production and ancillary systems that contain high pressure and flammable substances and that require to be opened for maintenance or other operations whilst the remainder of the process remains active.

2.2 Materials

2.2.1 Material for piping systems conveying hydrocarbon or other hazardous fluids is to be steel or other approved metallic material.

2.2.2 Material for piping systems conveying H_2S-contaminated products (sour service) is to comply with the most updated version of National Association of Corrosion Engineers (NACE) Standard MR 01 75.

2.2.3 Material for piping systems essential to the production and process operations is to be steel or other approved metallic material.

2.2.4 Specific provisions for piping material are reported in Part C Chapter 2. Many of the grades of pipe listed in ASME B31.3 are suitable for non-corrosive hydrocarbon service.

Design for corrosive hydrocarbon service should provide for one or more of the following corrosion-mitigating practices:

- chemical treatment;
- corrosion-resistant alloys;

- protective coatings.

2.2.5 Corrosion-resistant alloys that have proven successful in similar applications (or by suitable laboratory tests) may be used, however careful consideration should be given to welding procedures.

Since welding can significantly alter the corrosion-resistance of otherwise resistant materials, careful consideration is to be given to the development of welding procedures. Specific provisions for piping fabrication are reported in Part D Chapter 4.

2.3 Corrosion

2.3.1 Corrosion control for hydrocarbon production and process piping is to be provided according to the requirements of Part D chapter 6.

2.3.2 Corrosion allowance is to be provided for carbon steel hydrocarbon production and process piping as per NACE RP0176. The minimum corrosion allowance for different material will be established on a case by case basis.

2.3.3 For continuous and in service monitoring of corrosion within the piping systems, a regime of corrosion coupons or removable test spool pieces is to be included in the design of the relevant piping systems.

If test spool pieces are used as the means of monitoring they must be easily isolated, removed and replaced.

2.3.4 If it is considered necessary for the hydrocarbons being handled, sand probes, sand catchers and filters are to be provided to monitor and knock-out entrained sand and possible reservoir fracture elements.

2.4 Valve requirements

2.4.1 Quarter turn soft-seated valves and fittings which incorporate elastomeric sealing materials installed in systems containing hydrocarbons or other flammable fluids are to be of a fire-resistant type as per API Standard 607.

2.4.2 Suitable isolating valves, operable from the control stations as well as locally, are to be provided to isolate the unit from the supply and discharge of produced oil and gas.

2.4.3 Where locking of valves in open/closed position is foreseen, suitable keyed locking devices operated under a sequence which does not cause an unacceptable operating condition are to be provided.

2.4.4 If there is a necessity for personnel to periodically enter a vessel for inspection, maintenance or survey then means are to be fitted to fully isolate that vessel from the pressure and/or hazardous fluid systems. This is to be achieved by the installation of approved isolation valves and spectacle blinds. Double block and bleed isolating valves and if necessary a means to blank off open ended piping may be required following identification of the potential hazards and risk assessment of the hazardous scenarios.

2.5 Pipe connections

2.5.1 The number of detachable pipe connections in hydrocarbon production and process piping is to be limited to those which are necessary for connection to valves, expansion joints, spool pieces and similar fittings or where required for coating, lining, fabrication, inspection or maintenance.

3 Process equipment and vessels

3.1 General

3.1.1 Process pressure vessels and associated heat exchangers are to comply with the requirements of International Recognised Standards and/or Best Engineering Practices (i.e. GPSA, Gas Petroleum Standard Association).

3.1.2 Equipment used in production plants such as pumps, compressors or otherwise related to safety in conjunction with production, are to be in accordance with a recognized Standard and with the applicable requirements of International Recognised Standards and/or Best Engineering Practices.

3.1.3 The use of specific standard is subject to the approval by Tasneef according to the classification or certification purpose.

4 Pressure relief

4.1 Pressure vessels and pressure-rated equipment

4.1.1 All pressure vessels are to be fitted with pressure relief devices that are to be set not higher than the design pressure for the system. The devices are to have suitable capacity and characteristics to limit pressure build up within the limits of the design for the system or component. The devices are to be in accordance with API Standard 520-521 or ISO 23251. Use of other standards is subject to the approval by Tasneef.

4.1.2 The number, discharge capacity and installation of the said relief valves are to comply with a recognised standard.

The back pressure of the venting system is to be taken into account.

4.1.3 Block valves for maintenance purposes may be fitted upstream and downstream of the pressure relief valves provided that the following requirements are complied with:

a) suitable arrangements are provided to prevent more than one pressure relief valve being out of service at the same time;

b) a device is fitted which automatically and clearly indicates which one of the pressure relief valves is out of service;

c) pressure relief valve capacities are such that if one valve is out of service the remaining relief devices have the required combined relieving capacity.

4.1.4 All pressure-rated equipment, such as compressors and pumps, is to have protective relief devices fitted that will protect the piping from the effects of overpressure, unless if the piping is sized for the shut-off pressure of the equipment. These devices will relieve safely to either the flare, the atmospheric vent or the closed drain systems as applicable for their service and location.

4.1.5 The devices may take the form of pressure relief valves, a bursting disc or water seal designed, chosen and approved for that specific function.

4.2 Liquid hydrocarbon piping systems

4.2.1 Pressure relief valves that are installed in liquid hydrocarbon pipe section are to discharge to a sump or to a closed drain system the sizing of which has to take into account the number of relief valves discharging into it.

4.2.2 Pressure relief valves that are installed in liquid hydrocarbon pump delivery are to discharge back to the pump suction, to a drains system or to a sump. The option will depend on the dynamics of the system involved and the effects on other relief systems. The liquid hydrocarbon piping systems are to be in accordance with a recognized Standard and with the applicable requirements in International Recognised Standards and/or Best Engineering Practices. Use of specific standard is subject to the approval by Tasneef.

4.3 Gas hydrocarbon piping systems

4.3.1 Pressure relief valves in gas hydrocarbon piping are to discharge to one or more closed vessels that may be connected to the flare or gas vent system complying with requirements in [6 and 7].

4.3.2 The back pressure in the closed vessel is to be taken into account for the design of the pressure relief valves.

4.3.3 In the case of closed-in, liquid filled, liquefied gas piping, pressure relief valves are to be installed in case of pressure build-up in the piping, and they are to discharge into a relief valve header with the header being routed back to a storage tank. In general an interlocking key system is to be arranged for the return valves to the sump so that at no time is the relief header fully closed off. The gas hydrocarbon piping systems are to be in accordance with a recognized Standard and with the applicable requirements in International Recognised Standards and/or Best Engineering Practices (i.e. GPSA: Gas Processors Suppliers Association). Use of specific standard is subject to the approval by Tasneef.

4.4 Rupture discs

4.4.1 Rupture discs may be considered for use in systems where the substance contained within the system may render a relief valve ineffective.

4.4.2 The use of rupture discs upstream of pressure relief valves or in parallel to pressure relief valves will be considered on a case by case basis.

4.4.3 Where rupture discs are used in series with relief valves, or with another rupture disc, the volume between the two devices is to be monitored for leakage or pressure increase and an alarm initiated to indicate a change in this space. The devices are to be in accordance with API Standards 520-521. Use of other standards is subject to the approval by Tasneef.

5 Depressurizing (Blowdown) Systems

5.1 General

5.1.1 An emergency vapour depressurizing system is to be provided for all equipment processing light hydrocarbons with operating pressures of 1.7 MPa and above, to ensure safe disposal of hydrocarbons under normal operations and during emergency conditions.

5.1.2 The depressurization system is to be designed to be as simple as possible and according to the fail-safe philosophy. This implies that the blow-down valves are spring-return, and fail to the open position (open on loss of power).

5.1.3 The aim of the system is to be to gain rapid control of a situation in which for example in a closed process vessel is being overheated by a fire with subsequent pressure increase (e.g. it is acceptable to depressurize to 50% of the equipment design pressure if such depressurization is achieved within 15 minutes).

5.1.4 Calculations, showing that the maximum allowable temperature of the equipment would not exceed the equipment rated temperature, are to be submitted for verification. Reference can be made to Appendix A of API RP 521 for information on the effect of heat input to non-insulated steel vessels.

5.1.5 As these depressurizing systems can involve the expansion of a high pressure gas to a lower pressure then consideration is to be given to the cooling effect of expanding gases in this manner. Different gases exhibit different cooling effects and consideration must be given to materials and equipment used for the gases involved.

6 Flares

6.1 General requirements

6.1.1 Flares for hydrocarbons are to be designed according to API RP 521 or equivalent and installed so as not to cause hazards on the platform.

6.1.2 Flares are not to be installed in hazardous areas. Regarding the choice of their location on board, the area affected by the radiating heat during the maximum foreseen combustion activity is to be taken into consideration. As a general rule, the position in which combustion takes place is to be not less than 50 m away from the accommodation area, control room, etc. In particular cases, suitable barriers, for example sprayed water, may be used to reduce the area affected by the combustion activity of flares.

6.1.3 Means are to be provided to allow the combustion to be activated by remote control, to intercept the delivery of hydrocarbons in time and to send inert gas into the gaseous hydrocarbon piping inlet to the flare.

6.1.4 There may be a necessity, by virtue of a flare position, to reduce noise emissions. This can also be accomplished by water screens or other screening devices. Noise measurements of flares at their maximum intensity are to be taken to establish whether or not noise reduction measures are to be taken. As reference, acceptable maximum allowable level of continuous noise is 90 dB(A) within work areas using ear protection, 75 dB(A) in control areas and 60 dB(A) for accommodation areas.

7 Cold Vents

7.1 General requirements

7.1.1 For hydrocarbon vapour where disposal is by atmospheric dispersion from a vent stack, the vent outlet is to be of sufficient height or distance from the facilities such as to accomplish the following general requirements:

a) In case of accidental ignition, the calculated radiant heat intensity from the resulting flame (including solar radiation) is not to exceed 4.73 kW/m^2, at the maximum possible venting rate. This is to be considered the maximum at any deck level or location where normal maintenance or operating activities could take place, by personnel wearing adequate protective clothing.

b) In the event of accidental ignition, a snuffing system or equivalent is to be provided to immediately extinguish the flame. A flame arrestor is to be fitted on a vent system wherever a permanent or long standing relief is to be made from the vent system.

c) The following concentration of hazardous vapours, calculated as per API RP 521 or other equivalent standard, is not to be exceeded at any deck level where normal maintenance or operating activity could take place, based on the reasonable worst-case conditions (e.g., still air and low vent velocity):
   - 10 ppm for H_2S over one hour averaging time assuming none of H_2S entering in the flare is converted to SO_x.
   - 20% LEL for flammable vapours.

d) The vent outlet is to be at least 8 m above any immediately adjacent process vessel or hydrocarbon processing equipment, and at least 3 m above the top of any vessel or equipment within an 8 m radius of the vent.

e) Where a short vent stack is used in lieu of a vent boom, the vent outlet is to be provided with devices to prevent the passage of flame into the system, such as a flame arrestor. The pressure drop of the flame arrestor is to be considered in the vent diameter sizing calculations.

7.1.2 When a dispersion model based on a modelling method other than API RP 521 is used, a validation study of the model is to be made available for verification to confirm that at any point on the installation the concentration of hydrocarbons remains below 50% LEL.

7.1.3 Similar noise considerations for cold vents as for flares are to be taken into consideration.

8 Control, safety and ESD system

8.1 General

8.1.1 A control, safety and ESD system is to be provided for the production and process systems. It is to be in accordance with IEC 61508/61511 and ISO 10418 Recommended practice for Analysis, Design, Installation and Testing of Basic surface Safety or equivalent standard.

8.2 Systems for Offshore Production Platforms

8.2.1 In general, a single failure is not to lead to hazardous scenarios and/or spurious actuation of safety systems. Particular care is to be given to the redundancy of electrical power supply that feeds the control, safety and ESD system (e.g. UPS architecture).

There are to be two independent levels of protection to prevent or minimise the effects of a single malfunction or fault in process equipment and piping systems, including their controls.

The two levels of protection are be provided by functionally different types of safety devices to reduce the probability for common cause failures.

8.2.2 The following general issues are to be taken into account in the design:

- Human machine interface;
- Response time;
- Layout of alarms;
- Compliance with 89/336/EEC;
- Possibility of online testing;
- Software dependability;
- Environmental stresses.

8.2.3 Complete test of the whole control, safety and ESD system is to be performed and properly documented during pre-commissioning and commissioning.

8.2.4 Systems, actuated devices and controls are to be designed fail safe. This means that failure of the controls or associated systems will result in the system going to the operational mode that has been pre-determined as safest. This normally implies that shutdown valves will 'fail-to-closed' position, and depressurization valves, 'fail-to-open' position. Sensors are to be normally energised closed circuits and contacts.

8.2.5 Where required, stored energy devices for actuators are to be designed, located and protected to ensure that the fail safe function is not impaired by defined design accidental events.

8.2.6 Pneumatic and hydraulic systems are to be monitored. Process shutdown of such systems is to be initiated if pressure falls below a level where functionality is lost.

8.2.7 Activation of depressurisation valves may be incorporated in either the process or emergency shutdown.

8.2.8 Components which, for safety reasons, are required to maintain functionality for a specific period of time during an emergency (e.g. fire resistance of valves) are to be verified as having the appropriate qualifying properties, e.g. by tests, calculations etc.

8.2.9 Commands for manual activation of emergency systems are to be located at strategic positions where accessibility and manning in a hazardous scenario is properly considered, e.g.:

- Central control room;
- Helideck;
- Muster areas;
- Lifesaving appliances embarkation areas;
- Wellhead areas;
- Escape routes from process and wellhead areas.

8.2.10 Inadvertent manual activation of emergency systems is to be prevented.

8.3 Safety and Automation Systems (SAS) for Offshore Production

8.3.1 Emergency Shutdown (ESD)

Emergency shutdown systems are to be provided against hazardous event. An ESD include:

- Manual input device (push button);
- Interface with other safety systems, e.g.:
    - o Fire detection system,
    - o Gas detection system,
    - o Alarm and communication system,
    - o Process shutdown system,
    - o Fire-fighting system,
    - o Ventilation system.
- A central control unit (CCU) receiving and evaluating signals from the above definite systems, and create output system to device that are to be shut down or activated. The ESD central control unit is to include a device providing visual indication of initiated inputs and activated output and a local audible alarm.
- Output actuator as for:
    - o Relay,
    - o Valves and dampers,

  - o Including status indicator.
- Signal transfer lines between the ESD central control unit and all input device, interfaced systems and output actuators,
- Power supply.

The ESD basic principles and functional requirements are to contain the following features:

- The system are to be designed so that the risk of intentional shutdown caused by malfunction or inadvertent operation is minimized,
- The system is to be designed to allow testing without interrupting other system on board,
- The CCU is to be located in a non-hazardous and continuously manned area,
- The system is to be powered from a monitored Uninterruptible Power Supply (UPS) capable of at least 30 minutes continuous operation on loss of its electrical power supply systems. The UPS is to be powered from both the main and the emergency power system,
- Upon failure of shutdown system, all to default to the safest condition for the installation,
- Failures to be considered for the shutdown system are to include the broken connections and short- circuits on input and output circuits, loss of power supply,
- For a shutdown system with one or more normally energized outputs, all inputs are to be normally energized,
- For a shutdown system with one or more normally de-energized outputs, all inputs able to active a normally de-energized output are to be normally de-energized,
- All normally de-energized input and output circuits are to be monitored for broken connection and short-circuit,
- The shutdown system is to be designed to ensure that any ongoing operations can be terminated safely when a shutdown is activated,
- Shutdown on a hierarchical level are automatically to include shutdown on lower level,
- Shutdown is to initiate alarm at the control station. The initiative device and operating status of devices affected by the shutdown action are to be indicated at the control station (e.g. valve position, unit tripped, etc.),
- Plants that are protected by automatic safety system are to have pre-alarm to alert when operating parameters are exceeding normal levels,
- The shutdown commands are not to be automatically reset.

8.3.2 Process shutdown system (PSD system)

The PSD functions for hydrocarbon systems are to meet the standards ISO 10418 or equivalent; the systems are to be implemented in separate SAS unit(s) as to ESD system.

Function testing is to be possible without interrupting the operations of the installation. An overview of the PSD blockings is to be available in CCR. Fieldbus and RIO (remote input/output)'s may be utilised.

8.3.3 Package integration and categorization and definition of control classes

The process and utility equipment packages can be integrated into the SAS, and the operation and control will be carried out accordingly. The individual package unit can have different operation and control philosophy within an installation, depending on operational requirements.

- Control class 1: All control functions fully integrated utilizing project standard software and control unit hardware.
- Control class 2: Control units are either directly connected to main SAS network or interfaced to other SAS units utilizing project standard hardware or software interface.
- Control class 3: Stand-alone control units. These control units are not considered as SAS units and no interface to SAS is required.

For all equipment packages categorized as Control class 2, a more detail overview should be prepared. This overview should set up project requirements for the various control functions with respect to:

- documentation of application program (i.e. use of System Control Diagram);
- use of project standard function blocks;
- use of project standard control units;
- use of project standard hardware or software interface, including operator interface.

8.3.4 Systems for Offshore Production Platforms Test
The individual SAS are to tested for hardware and software application; several SAS units forming a systems for offshore production platform and they are to tested. The tests shall be performed in accordance with approved test procedures.

9 Loading arms

9.1 General requirements

9.1.1 Loading arms are to be designed and constructed in accordance with recognized national or international standards acceptable to Tasneef. Loading arms for LNG transfer are to meet the standards EN1474-1 (2009).

9.1.2 A Quick Connect Disconnect Connection (QCDC) is to be provided for the coupling of loading arms to the carrier manifold.
In addition to the QCDC, an emergency release system is to be fitted. This forms a second stage Emergency Shut Down (ESD) system in addition to the cargo transfer system's ESD. Its purpose is to provide the means to quickly uncouple the transfer hose with minimum product release to the environment. The system disconnection is to be achieved by means of a Powered Emergency Release Coupler (PERC) which provides the interlocks to prevent the coupling from releasing before the safe closure of the valves.

9.1.3 Means are to be provided for the activation of the disconnection system from the control station and locally in the vicinity where the disconnect arrangements are located.

The disconnect arrangement is to be designed such that upon its activation, all process flow from the platform to the carrier is automatically stopped immediately with minimal leakage of process fluids.

10 Ancillary systems

10.1 General requirements

10.1.1 Ancillary systems (e.g. steam, heating medium, cooling medium, compressed air, etc.) serving systems containing flammable or toxic liquids or gases are in general not to be connected to non-hazardous systems or similar systems located in non-hazardous areas.

10.1.2 Where the above is unavoidable or impracticable such interconnections is to be designed to eliminate or control the risk of cross-contamination to an absolute minimum. This may be mitigated by the use of protective measures such as:

a) Identification of possible failure modes and an identification of realistically acceptable leak size.
b) Evaluation of the consequences of a cross contamination.
c) Monitoring of the fluids involved and the use of proven equipment to maintain segregation of the fluids (e.g. non-return valves, primary and secondary circuits, liquid seals, detectors etc.)

If it is found that the risk of cross contamination is high and the consequences of such are found to be significant , and any protective measures that have been envisaged are difficult to verify or maintain, then the systems are to be separated.

11 Static electricity

11.1 General

11.1.1 The generation of static electricity occurs widely in platform operations, but with an understanding of the mechanisms involved and appropriate design procedures, the hazard of ignition of flammable concentrations by electrostatic discharges can be effectively eliminated.

11.1.2 Specific reference is to be made to API 2003, “Protection Against Ignition Arising out of Static, Lightning, and Stray Currents” or equivalent.

11.2 Static Electricity in Platform Installations

11.2.1 Premises

Liquids with relatively low electrical conductivity are capable of accumulating potentially hazardous electrostatic charges. Low conductivity liquids are essentially non-polar and are comprised mainly of distilled petroleum products. Several distillate products, as heating oil, diesel oil, kerosene etc., are static accumulators.

The stockpiling typically have an electrical conductivity of 50 pico siemens per meter or less.

Non-accumulating liquids include crude oil, residual products with Conradson Carbon above 1%, and oxygenated, polar solvents such as alcohols, MTBE, and MEK. LPG and other volatile materials, which are handled in closed, air-free systems, present no hazard with respect to electrostatic ignition.

Although static can be accumulated and may discharge sparks, there is no flammable vapour/air mixture. When an additive is used to increase conductivity, typically due to customer requirements, the liquid should still be handled as an accumulator.

Operations, which are of particular concern because of static electricity generation, include the following:

- Liquid droplets falling through a vapour, e.g., spray or mist formation in vapour spaces, and splash filling of tanks, even hydrocarbon mists of non-accumulators;
- High velocity and turbulent conditions, e.g. in pipelines, at the discharge of jets from nozzles, tank mixing, etc.;
- Filtration, particularly through micropores or sintered metal elements with a large surface area exposed to fluid flow;
- Settling of water droplets through liquid hydrocarbons, e.g., in tankage.

11.2.2 Principles of Avoiding Electrostatic Ignition

The widespread application of electric power in platforms presents many opportunities for the generation of electrical sparks. Sparking may be the result of a fault in an electrical component, or may occur as a normal feature of the working of an electrical device, e.g., the sparking at the contacts of a switch when opening or closing.

The materials under consideration are to be first classified as static accumulators or non-accumulators.

They are then classified as high, intermediate or low vapour pressure products, according to their flammability characteristics at the conditions applying in the equipment under consideration.

Elimination of the electrostatic ignition hazard may be achieved by either of the following basic methods:

- Eliminating conditions and equipment configurations which favour the generation, accumulation, and sparking discharge of electrostatic charges,
- Eliminating flammable vapour/air mixtures at points where sparking discharge of electrostatic charges may occur.

11.2.3 Application of Local Codes and Approvals

Local area classification codes and equipment approval by recognized testing organizations should be applied where appropriate. Established design and operating requirements are available, appropriate to the above considerations, covering all process items.

12 Pre-commissioning, commissioning and start-up

12.1 General

12.1.1 The overall compliance of the process and production system with safety criteria is to be verified during the pre-commissioning, commissioning and start-up according to the procedures sent to Tasneef.

12.1.2 Pre-Commissioning activities include:

- checking for design conformity, checking the status of electrical,
- mechanical and instrument installations,
- running-in of equipment,
- flushing and cleaning activities, drying etc.

12.1.3 Commissioning is the phase in a project when design process fluids are introduced to the process and the activities normally consist in:

- activities associated with running or operating the plant and include operating adjustments necessary for satisfactory operation of the plant or part thereof.

13 Electrical system

13.1 General

13.1.1 This Section contains provisions for electrical installations at all voltages to provide safety in the design of electrical systems, selection, and use of electrical equipment for generation, storage, distribution and utilization of electrical energy for all purposes in platform. In general, the provisions of IEC 61892 apply.

13.2 Materials

13.2.1 All equipment and materials should have low halogen content. Equipment enclosures located outdoor, in naturally ventilated areas and wash down areas, are to be made of proven sea water resistant material or protected by a coating system according to international standard. Electrical/electronic equipment in panels are to be protected against hydraulic leakage.

13.3 Power supply system characteristics

13.3.1 For harmonic distortion (voltage waveform) (see IEC 61892-1, 4.9.2.2) the detailed harmonic voltage acceptance limits are to correspond to IEC 61000-2-4, Table 2 class 2, for any voltage. In addition the fifth harmonic shall not exceed 5 % for the high voltage system.

13.4 Maintenance and inspection

13.4.1 Electrical equipment are to be designed to allow for thermographic on load inspection or use of thermostrips, where possible.

13.5 EMC protection and fire protection of cables

13.5.1 Cable entries which require EMC protection are a result from the relevant engineering studies and should be specified in datasheets or similar. For the fire protection reference is to be made to IEC 60331- 21/31 as applicable.

13.6 Location of electrical equipment in units

13.6.1 Major electrical equipment are normally all electrical MCC and distribution boards/panels, all 3 phase motor starters and feeders including contactors and breakers, all 3 phase transformers, battery chargers, and frequency converters.

13.6.2 In order to avoid installation of major electrical equipment in hazardous areas or in exposed environments, all major electrical equipment are to be installed inside equipment rooms with a controlled atmosphere. In addition control panels containing PLC, etc. should be avoided in hazardous areas or in exposed environments.

Location of high voltage equipment is to comply with recognized practice such as “Safety Regulations for Work and Operation of Electrical Equipment and Installations”.

The room is to withstand the highest blast pressure caused by short circuit without any damage. Doors to high voltage rooms are to open out from the room. Hinged doors shall be provided with “panic opening device” which can be opened without using the hands.

13.6.3 Oil filled transformers can be located in naturally ventilated areas. Location of electrical equipment are to be selected to avoid interference with escape routings, walkways, other equipment, pipes etc. and obstruction against activities related to transport and lifting operations. Field equipment such as public address flashing lights, loudspeakers, junction boxes, splitters and tap-off, may be located on the support for cable ladders and trays or on the side rail of the cable ladders.

13.6.4 Field equipment may be mounted underneath cable ladders or as integrated part of handrail support arrangement.

13.6.5 Equipment is not to be mounted on blast walls/explosion reliefs. Equipment can, however, be installed on the support frames for the blast walls if the integrity of the blast wall is not reduced. Equipment located in areas which do not allow for maintenance accessibility as required, should be installed such that the equipment can be rotated, raised or lowered into areas where maintenance can take place without the need for scaffolding.

13.7 Mechanical protection

13.7.1 Special attention is to be given to protection of electrical equipment against mechanical damage in storage, loading and other exposed areas.

13.8 Protection from heat, water, steam and oil

13.8.1 Full scale testing of deluge system may take place. Selection and installation of equipment should be such that adverse effects to the equipment due to testing are minimized. Equipment located in areas where deluge testing will take place are to have degree of protection at least IP 56.

14 Requirements for system and equipment isolation

14.1 General

14.1.1 It is to be possible to isolate equipment, instrumentation, valves and process sections during maintenance work to obtain safe working conditions for the maintenance personnel. It is recommended to test the integrity of all valves that will be used for isolation (normally by including bleed valves).The minimum isolation level required is to be thoroughly considered for all systems where intervention during operation can be required. This consideration is to be based on the risk associated with the intervention operation, including

- requirement for equipment entry during operation,
- fluid category (level of hazard involved, e.g. flammability, toxicity),
- operating pressure and temperature,
- pipe dimension and system volume,
- duration of operation,
- frequency of operation.

14.1.2 Specific criteria for selection of isolation level are to be provided by project owner. The type of valves selected for isolation purposes are to be based on a thorough evaluation of requirements and inherent valve characteristics.

14.2 Physical separation

14.2.1 This is the highest standard of isolation and is accomplished through one of the following arrangements to prevent seepage of any fluid:

- spectacle blind;
- spade and spacer;

- spool piece to be removed and blinding off the open pipe end.

An initial isolation is normally required to be in place in order to install a physical separation.

14.3 Insulation and heat tracing of piping and equipment

14.3.1 Due to corrosion under insulation being a general problem, the philosophy is to be to avoid insulation, where possible. Appropriate coating systems shall be selected to minimize this problem. The insulation and heat tracing requirements are to be determined with due consideration to safety aspects as well as to process aspects and with the objective to minimize life cycle cost. All operating modes are to be considered.

14.4 Heat conservation and frost protection

14.4.1 Heat conservation (insulation or insulation + heat tracing) is to be applied where there is a potential for hydrate formation or other solidification, for the following functions:

- upstream pressure safety relief devices and blow-down valves;
- for process safety instrumentation, including instrument connections and impulse lines.

14.4.2 Such heat conservation shall be regarded as safety critical. A design, commissioning, operation and maintenance philosophy shall be established and implemented to ensure proper performance of safety critical heat conservation and heat tracing. The heat conservation shall be specified to maintain temperature above the hydrate formation/solidification temperature with a minimum margin of 5 °C.

15 Firefighting facilities

15.1 General

15.1.1 This section covers the conceptual design of systems intended for incipient and first-phase firefighting in a platform. The extent and capacity of the firefighting equipment provided in a platform or associated facilities are based on the assumption that only one major fire will occur at any one time. Thus, the requirements of the largest single fire contingency determine the design of the major firefighting facilities. Process units, ship berthing and/or mooring areas, loading racks, tankage and pressurized storage facilities are typically the areas of higher fire risk.

15.1.2 In a process area, firewater application is the most effective firefighting method for reducing plant damage while the source of fuel is being isolated from the fire. Water is applied to exposed structures and equipment for cooling to prevent further failures and minimize damage until the fire is extinguished, usually by shutting off or exhausting the fuel supply. In some instances (e.g., spill fires) foam can be effectively used.

15.1.3 Loading racks and ship terminals that handle flammable or combustible materials require both cooling water and foam protection, since hydrocarbon liquid spill fires can be expected for which foam is the most effective means of extinguishment. Water is the primary mean of protection for facilities that handle LPG or similar volatile materials.

Connections must not be made into the fire main chain to supply regular process or utility requirements or for recurring line flushing or product displacement purposes.

15.2 Design procedures

15.2.1 General

Design requirements for firefighting facilities in platform are as described below (ref. NFPA 11-13-14-15-16-20).

15.2.2 Water Flow Rate Determination

The assessment of the fire water capacity requirements of a process unit is based upon a number of established considerations and well-tested principles.

Typically each process block will be split into a number of subdivisions for the purpose of establishing the maximum extent of any single fire and thus the fire water capacity requirement of that area.

Additional potential capacity is to be evaluated and consequently provided by means of mobile equipment such as large diameter hose and portable or mobile pumps through the local mutual aid system.

The fire water demand for each subdivision will be based upon an application rate varying between 0.1 and 0.3 gpm per ft^2 [0.25 and 0.75 m3/(h*m^2)] of area depending on equipment density.

Compact and multi-story units with a high density of stacked equipment (exchangers, drums etc.) or units containing an unusual amount of high-risk equipment (e.g. pumps handling flammable liquid above 600°F / 316°C or above auto-ignition temperature) will require the higher rates. Similarly, consideration of the likely provision of first phase for fighting equipment (monitors, deluge systems and hose reels) may be a useful cross check on capacity requirements.

15.2.3 Recommended Minimum Requirements

The following minimum requirements are recommended in FFS design for a fixed offshore platform:

- Utility plants: 1500 gpm (341 m3/h)
- Loading racks: 1500 gpm (341 m3/h)
- Large central pumping areas and similar facilities: 2000 gpm (454 m3/h)
- Separators and waste disposal systems: 1000 gpm (227 m3/h)
- Office buildings, workshops, storehouses, etc.: 1000 gpm, (227 m3/h) plus sprinkler requirements if specified

15.2.4 Water Source

More than one source is required where the maximum demand for process facilities is greater than 6,000 gpm (1363 m3 /h).

Where the water source is limited, an acceptable alternative is to provide a firewater storage system. This storage must be large enough to provide full design flow for a minimum of 6 hours without shutting down the process or other water-using operations in the platform. Also, the water-source must be capable of supplying one-half the maximum water demand on a continuous basis after the storage capacity has been used. The continuous supply at one-half the maximum demand rate can be based on taking credit for shutting down non-critical process facilities by the end of the 6-hour period, if this is feasible.

15.2.5 Pump and Driver

Total pump capacity requirements shall be provided in the form of at least two pumps, having different types of driver. The only exception is for facilities with a total demand of 1500 gpm (341 m3/h) or less. At least one pump should be electric motor driven and at least one pump should be diesel engine driven. Where more than two pumps are required they should be of equal capacity and an appropriate selection of drivers should be specified to give maximum reliability. Where two electric driven pumps are to be utilized, they shall be fed from separate power supplies, that is to be arranged such that the failure of one supply will not cause an interruption of the other source. The firewater main is to be designed to operate continuously at 125 psig (860 kPag) at the pump discharge manifold.

A return line with a flow-measuring device shall be provided for periodic testing of firewater pumps. The flow-measuring device shall be sized for at least 175 percent flow of the largest firewater pump. Isolation valves shall be provided to permit isolation and maintenance of an individual pump while the other pumps remain in service.

A small pressurizing pump (commonly called a jockey pump) manifolded in parallel with the main firewater pumps, is to pressurize the system when the latter are not in use. Rated capacity is normally 300 to 500 gpm (68 m3/h to 114 m3/h) at 125 psig (860 kPag). This quantity is not included in the total firewater pump capacity.

A low-pressure cut-in with alarm shall be installed on the pump discharge manifold, set at 100 psig (690 kPag), to actuate an automatic starting device on the electric motor driven firewater pump. Remote start control of this pump is also provided at a continuously attended control room or at the firehouse. Where more than two firewater pumps are provided further pressure drop shall automatically start secondary fire water pumps to meet at least 50% of the total required pumping capacity, with a 5 - 10 second timed delay. The remaining diesel or electric driven firewater pumps may be manually started from a constantly attended location or can be automatically started as the firewater demand continues to increase. As a backup to the main firewater pumps, multiple hose connections should be installed on the platform at two separate berths so that fireboats or tankers can pump into the refinery main.

15.2.6 Firewater distribution system

A grid or looped piping distribution system shall be used, capable of supplying water, on a single fire basis, to any part of the refinery at the design rate determined for that specific area. The design is based on water flow through all loops and mains of the grid system, and the lines are sized to provide 80 psig (552 kPag) minimum hydrant (residual) pressure at full design flow rate. Piping should be sized conservatively to account for fouling and increased roughness caused by aging. Firewater networks are typically designed using the Hardy Cross method of analysis. PC based software is available to optimize pipe sizes in order to obtain a reliable and economic design. In the absence of other programs, the following combination of the Hardy-Cross, and Hazen and Williams methods may be used for sizing the pipe:

$$Q = 0.0368\ c\ d^{2.63}\ p^{0.54}$$

where:

- Q = Flow rate, gpm
- c = Hazen-Williams Coefficient, dimensionless
- d = Inside diameter, in.
- p = Pressure drop, psi per 100 ft of pipe

The fire main grid shall be designed with isolation valves, which permit sections to be taken out of service for repair while still retaining half the design capacity to each area.

15.2.7 Fixed Water Spray / Deluge Systems

Fixed water spray / deluge systems may be utilized as first phase firefighting equipment for either exposure cooling of vessels and equipment likely to be exposed to fire or fire intensity control on equipment that may be a source of fire (typically pumps and compressors in flammable service). In process areas open head dry-pipe systems, manually activated by a valve located a minimum of 50 ft (15 m) from the equipment being protected and easily accessible to operators, are used. These systems shall be designed in accordance with NFPA 15 or equivalent rule. Application rates can vary from 0.15 gpm per ft2 (0.37 m3/h*m2) for cooling of spheres and spheroids to 1.3 gpm per ft2 (3.1 m3/h*m2) for the internal firewater spray system for regenerative air preheaters (see Step 6 of the selection procedure and Table 2, below). The use of individual fixed water spray systems having a total capacity in excess of 2000 gpm (454 m3/h) is generally not recommended as they can result in poor efficiency of water usage.

Spray heads may be upright type or pendant type, depending on local preference and shall have a minimum orifice opening of 3/8 in. (10 mm) to minimize the risk of plugging. Fixed water spray system piping downstream of the system strainers should be copper-nickel or galvanized.

Regular testing is necessary to ensure system availability and maintenance program.

In the following Table 1 it is reported the typo of critical equipment or unit with relevant first phase of firefighting equipment. To this aim, fixed monitors are to be preferred, unless otherwise required.

Type of critical equipment or unit	Application of First Phase Fire Fighting Equipment
Process Unit Towers	For externally insulated column-type vessels, their reboilers and their hot oil piping and bottom connections
Process Unit Pumps and Compressors	Ensure coverage of motors and seal areas plus lube oil console for compressors
Pressurized (horizontal) Storage Vessels	Entire coverage of single or two vessels within 50 ft (15m) of each other, when not fireproofed.
Process Unit Heaters	Only for exposed return bends and crossovers (1).
Multilayer Pipe Racks in Congested Areas	Where multilayer pipe racks are surrounded by congested process equipment and there is the possibility of any spillage from damaged piping to accumulate under the rack, then elevated monitors shall be provided

Table 1 - Application of first phase firefighting equipment

Note: (1) Monitor coverage is not normally required for process heaters as exposure to fire is not likely to result in immediate damage or loss of containment. The primary vulnerability of heaters to damage relates to split tubes. Where this could result in significant spillage and drainage capability is limited then monitor coverage may be justified as a means of washing the spill away from the vicinity of the process heater to a less hazardous location.

15.2.8 Sprinkler Systems

Sprinkler systems designed and installed as per NFPA 13 or equivalent rule are required for high-risk indoor facilities.

The sprinkler system shall provide adequate coverage for the relevant fire scenarios, with respect to area coverage on horizontal and vertical surfaces.

The delivered flow rate of water shall be:

- 10 (l/min)/m2 in utility areas, helicopter hangars,
- 6 (l/min)/m2 in LQ.

For other areas the protection should be in accordance with ISO 13702.

15.2.9 Fire Extinguishers

Portable fire extinguishers shall be provided to enable operating personnel to quickly attack small fires. They should be located at process areas, loading racks, pump areas, and similar facilities. Travel distance from the protected equipment to an extinguisher should not exceed 50 ft.

Extinguishers are located at grade and on major operating platforms such as in compressor houses, on mountings which are well marked and clear of the ground or platform.

Three basic types of extinguishers are used:

- Dry chemical extinguishers (potassium bicarbonate powder pressurized with nitrogen). They are suitable for flammable vapors and liquids and can be safely used on electrical equipment.
- Carbon dioxide extinguishers are recommended for electrical fires but can also be used on small flammable liquid fires. Carbon dioxide has limited effectiveness in the open, because of wind currents. Therefore, its use is normally restricted to areas such as laboratories and electrical substations.
- Pressurized or carbon dioxide-expelled water extinguishers are primarily used in offices and warehouses where wood and paper fires may occur.

RULES FOR THE CLASSIFICATION OF STEEL FIXED OFFSHORE PLATFORMS

Part D

Chapters **1 2 3 4 5 6**

PART D CHAPTER 1

MATERIALS FOR STRUCTURES

1 Type of Materials

1.1 General

1.1.1 Materials deemed appropriate by Tasneef with regard to workmanship procedures and service conditions are to be used for the construction of structures.

1.1.2 Mechanical properties, including toughness, steel chemical composition and manufacturing process will be taken into consideration, as well as resistance to corrosion, fire resistance properties etc.

1.1.3 The specification of each material shall be submitted to Tasneef for approval. This is to include the above-mentioned properties as well as recommendation of material testing, including non-destructive testing.

1.1.4 In general, within the established limits of application, weldable steels that meet the characteristics required in Section 2 for the different classes, according to structural categories described in [1.2] are acceptable for structural application.

1.1.5 These Rules apply to materials with a maximum thickness of 70 mm. If thickness is greater than 70 mm, the materials shall be approved by Tasneef with the necessary modifications in each case.

1.1.6 Approval of other types of steel with respect to both chemical composition and mechanical properties is given by Tasneef on the basis of the specification of steel properties, applicable technological instructions and evidence of acquired experience.

1.1.7 Workmanship procedures and welding processes shall be such that the properties and soundness of base materials and of the welded joints are consistently uniform. Relevant fabrication and welding specifications and procedures are to be approved by Tasneef as specified in Part D Chapter 3.

1.1.8 Unless otherwise stated, manufacturing, testing, installation and use of materials have to comply with the requirements specified in the relevant Parts of the Rules.

1.2 Type of materials according to structural category

1.2.1 Materials for structural use are to be selected following to two methods defined in ISO 19902:2007 Clause19. These methods are generally referred to as:

a) Material category (MC) approach

b) Design class (DC) approach.

These two methods are mutually exclusive and once one of them is selected it is not interchangeable at any stage with the other. The flow chart of the selection process is given in ISO 19902, Figure 19.1.1.

1.2.2 Steels are to be selected as belonging to a strength and toughness class for the purpose of material selection and use in offshore structures:

- Strength groups are defined by a range of yield strength, determined by tensile testing (ref. [2.3]);
- Toughness classes are determined by the ability of steels to achieve a minimum Charpy V-Notch (CVN) test energy at a specified minimum temperature. Toughness becomes more important as the magnitudes of varying actions increase and as the criticality of the structure increases. The LAST (lowest anticipated service temperature) is to be considered in accordance with applicable regulatory requirements in the region of application; in lack of more appropriate determination, suggested values of LAST for some areas are given in A.19.2.2.4 of ISO 19902:2007. Minimum toughness requirements for structural steels are defined in Table 19.4-1 of ISO 19902:2007.

1.2.3 Following the Material Category approach (MC) the steel are to be selected on the basis of the designed yield strength and toughness level in combination with the structure exposure level (see Part B Chapter 1, [1.2]).

An appropriate material category can be selected according to the following recommendation in compliance with ISO 19902:2007 Annex C Par. C1:

- MC1: this category is to be generally applied for exposure level L1 structures.
- MC2: this category is to be generally applied for exposure level L2 structures.
- MC3: this category is to be generally applied for exposure level L3 structures.

The required toughness class is determined by ISO 19902:2007 Table C.1 of the Annex C according to the following guidelines:

a) Type of component;

b) The material category (MC) of the structure;

c) The steel group, which is based on SMYS (specified minimum yield strength) as shown in Table 1, where the SMYS is previously defined along with the thickness by design analyses.

1.2.4 The Design Class (DC) approach for selecting the appropriate material strength group and toughness class is based on a component's criticality rating: DC1 to DC5, being DC1 the most critical.

If the DC approach is selected the provisions of ISO 19902 Annex D applies. In particular the required toughness class may be selected according to Table D.3.

1.2.5 Pipes fabricated according to API 5L may be purchased, provided they satisfy all the requirements of these Rules. Pipes shall be of quality PSL2 ordered for offshore service, in accordance with Annex J of API 5L (with exception of grade A25), and may be seamless or longitudinally welded with SAW procedure up to a maximum diameter of 508mm (20"). For conductor pipes the maximum diameter is limited to 762mm (30").

Welded and seamless pipes shall undergo non-destructive examination according to the requirements of these Rules. The mechanical properties of the finished products are to be in accordance with the requirements of API 5L and the impact test requirements with items 2.3.2 to 2.3.7 of these Rules.

1.2.6 Pipes for structural components are to be supplied in the normalised, quenched and tempered, TMCP or normalised rolled condition. U-Ing, O-Ing and Expanding process (UOE) is acceptable. Spiral welded pipes are not allowed. The accepted steel production processes are basic oxygen and basic electric arc furnace.

1.2.7 Pipes fabricated according to ASTM A53/A53M may be purchased, provided that they satisfy all the requirements of this specification.

2 Weldable Structural Steels

2.1 General Requirements - Manufacturing procedure - Finishing grade and tolerance

2.1.1 The steel is to be made by basic oxygen or basic electric arc furnace process. All steels are to be fully killed and made by fine grain practice.

2.1.2 Supply conditions of steel plates sections and hollow welded and seamless pipes are to be specified by the Manufacturer.

Intermediate or finished products, produced by the continuous casting route shall be examined for centre line segregation in accordance with the manufacturer's procedures and as agreed by the purchaser. This does not apply to seamless hollow sections.

2.1.3 The minimum rolling reduction ratio of material made by continuous casting for plate is to be 4:1 except for piling where it is to be 3:1.

2.2 Chemical Composition

2.2.1 The chemical composition for all the steel grades determined by ladle analysis is to comply with the values of applicable specification for the steel manufacturing.

Commonly used specifications for steel plates, steel shapes and steel tubulars are listed in Annex C and Annex D of ISO 19902:2007 within the context of the MC or DC approach respectively.

In case that EN10225-4:2004 is applied, Table 4 is to be considered for plates, Table 6 for sections and Tables 8 and 10 for hollow welded and seamless respectively.

The actual specified chemical composition of each type of steel is to be submitted by the Manufacturer to Tasneef for approval.

2.2.2 Sampling and preparation of samples for the determination of steel composition shall comply with ISO 14284.

Tolerances of product analysis, regarding composition of ladle analysis, are to comply with international standards recognised by Tasneef.

2.2.3 For ladle analysis determined for each cast, the values reported by the steel manufacturer shall apply. Product analysis shall be supplied by the steel manufacturer when required by Tasneef.

2.3 Mechanical Properties

2.3.1 Steels are grouped according to the SMYS (Specified Minimum Yield Strength) level as presented in the following Table 1 according to ISO 19902 Table 19.3.

Table 1 - Steel grades allowed according the SMYS

Steel Group	SMYS range requirements
I	From 220 MPa to 275 MPa
II	> 275 MPa to 395 MPa
III	> 395 MPa to 455 MPa
IV	> 455 MPa to 495 MPa
V	> 495MPa

In case that European Specification is applied, the SMYS requirements are to be selected according to EN 10225-4 (Tabs 5a-5b-5c-5d-7-9-10) and EN10025-2 (Tab 7-8-9), where the SMYS is defined for different product thickness and grade.

2.3.2 Minimum toughness requirements are to comply with those indicated in Table 19.4-1 of ISO 19902:2007, in consideration of the recommendations specified in its Clause 19.4.

Correlation of steel groups and toughness class for steel plates, structural steel shapes and structural steel pipes to US or European Specifications is introduced by ISO 19902:2007 in Table C2, C3, C4 or D4, D5, D6 respectively.

In case that European standards are applied, Charpy V-notch impact test requirements are to comply with the values of the EN10225-4:2004 (Tabs. 5a-5b-5c-5d are to be considered for plates, Tab. 7 for sections and Tabs. 9-10 for hollow welded and seamless respectively) and EN10025 (Tabs. 7-8-9). These tables are to be applied both for the requirements of minimum energy (J) and tests temperature.

2.3.3 Charpy V-notch properties other than those specified in [2.3.2] may be accepted by Tasneef according to equivalence criteria and based on the results of alternative toughness tests.

Additional toughness tests may be required by Tasneef for materials to be applied in severe conditions (e:g. high mechanical loads, low temperature) for special components. Tasneef may request the submission of some or all of the results of tests performed.

Tests are to be performed in compliance with EN 10225 10.2.5 or recognised international standards; testing conditions and extension are to be approved by Tasneef.

2.3.4 Assessment of the mechanical properties including CV-N Impact tests may be required even after "stress relieving heat treatment", depending on the application.

2.3.5 Testing temperature requirements may be increased by Tasneef for structural parts submitted to post-weld stress relieving heat treatment

2.3.6 When improved deformation properties perpendicular to the surface are required (see EN 101649), the average value of the reduction in area on tensile test specimens obtained in perpendicular direction with respect to the surface direction is not to be lower than 25% and the minimum value is to be not lower than 20%. In particular circumstances, the average and minimum values may be required to be 35% and 25%, respectively.

2.4 Additional Requirements

2.4.1 Additional requirements are to be considered with reference to EN-10025 and EN-10225 Section 13 "Options".

Generally the following is to be satisfied:

- For plates and hot rolled sections fabricated in accordance with EN 10025-2-3-4 the options of section 13 with a possible exclusion for:
  - o EN-10025-2 options 3-5--11-22-20 EN-10025-3-4 options 2-5-9-11a-13-14-30-
- For plates and hot rolled sections fabricated in accordance with EN 10225 options 2-6-7-9-10-11-12-13 (for quality Z

The Designer has to indicate for each of the above specified options whether the requirements is selected or not and to document a rational for the exclusion.

2.4.2 Design is to cover the following additional requirements:

- Steel for quality Z for thickness above 50mm is to be produced with special manufacturing process including vacuum degassing, desulphurisation and calcium treatment;
- Steel EN-10225 for quality Z is to be additionally tested in accordance with EN-10164 Class Z35 and proving al least 80% of the specified ultimate strength;
- A restricted Ladle and product analysis are to be agreed at the time of the order for steel when design class DC1 and DC2 (defined as ISO 19902) and Z quality (defined as EN10025 and 10225) are selected. The content of P and S is to be agreed at the time of the order;
- Plates EN-10025 of quality Z and thickness higher than 50 mm to be ultrasonically tested on the edges in accordance with EN-10160 and applying acceptance criteria S1/E2 for quality Z and S0/E1 for other plates;
- Hot rolled sections are to be inspected in accordance with EN-10306 with quality class 1.2 and 2.1 for design class DC1, DC2 and DC3;
- Steel plates for quality Z are not allowed to be repaired by welding.

2.5 Tests

2.5.1 General requirements

Tests are to be performed on the material upon delivery. Inspection and testing procedures are to comply with EN 10225 paragraphs 9 and 10 and with ISO 10025 par. 8-9-10. In addition, a check of the properties on separate samples submitted to the same treatment may be requested for materials that are intended to be post-weld heat treated.

The type of check required is to be specified by the purchase order and agreed with Tasneef. If no check is specified, Tasneef reserves the right to subsequently request the check according to the alternative specified in above mentioned standards (EN 10225 and ISO 101025).

2.5.2 Material test certificates

Structural steel materials for components design class DC1, DC2, DC3 and DC4 are to be provided with material test certificate EN-10204 type 3.2. Other steel materials are to be provided with material test certificate EN-10204 type 3.1.

2.5.3 Material of existing structures

Assessment of structural steel materials of existing structures is to be performed by Tasneef for compliance with the requirements of the present Chapter of these Rules. Steel materials manufactured, tested and certified in accordance with other internationally recognized standards are evaluated by Tasneef on the basis of their equivalence with these Rules. Deviations from the Rules are considered by Tasneef on the basis of documented engineering justifications provided by the Owner, the Designer or the Manufacturer. Final proof of structural integrity and fitness-for-purpose for desired life extension is to be considered the general basis for approval.

3 Grout materials

3.1 Cement

3.1.1 General requirements

Cement grout for pile-to-sleeve connections and grouted repairs (e.g. grouted clamps) are to be provided in compliance with ISO 19902:2007, Clause 19.6

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PART D CHAPTER 2

MATERIALS FOR PROCESS PIPING SYSTEMS

1 General

1.1 Application

1.1.1 This part of Tasneef Rules is intended to specify minimum requirements, quality controls and testing for the steel pipes and components applied in process piping systems on offshore production platforms for the petroleum and natural gas industries.

1.1.2 The materials are to be selected according to ISO 13703 and ASME B31.3 and the classification therein reported is adopted (Table 1).

1.1.3 If corrosive hydrocarbon service is of concern additional requirements for material selection are to be in accordance with ISO 15156. Corrosive hydrocarbon service is defined in ISO 13703 Section 3.1 - Terms and definitions *"service in which the process stream contains water or brine and carbon dioxide (CO_2), hydrogen sulfide (H_2S), oxygen (O_2) or other corrosive agents under conditions which cause corrosion of metal"*,

1.1.4 The materials suitable for the application in process piping systems on offshore production platforms can be selected either from existing materials lists (referring to mentioned ASME and ISO standards) or on the basis of field experience and/or laboratory testing.

1.1.5 The Owner or the Designer has the responsibility for preparing a piping material selection and related material specifications complemented by piping classes/specifications to define materials in relations with fluid service and operating conditions. The documents are to be issued for Tasneef review and approval.

1.1.6 Assessment of existing piping system material records is to be performed by Tasneef for compliance with the requirements of ISO 13703, ASME B31.3 and ISO 15156 when required, and these Rules. Material records completed in accordance with other internationally recognized standards are evaluated by Tasneef for their equivalence with these Rules. Deviations from these Rules are considered by Tasneef on the basis of documented engineering justifications provided by the Owner or the Designer. Final proof of material and suitability for the intended service and process working conditions for the expected life is the basis for approval.

2 Material selection

2.1 General

2.1.1 When selecting materials for piping systems on fixed offshore platforms attention is to be paid to:

- mechanical properties (e.g. yield, ultimate, elongation, toughness);
- corrosion, especially from internal fluid (uniform metal loss, pitting, corrosion-erosion, chloride stress-corrosion cracking, sulfide stress – cracking, hydrogen - induced cracking, etc.);
- compatibility with other materials;
- suitability for the service and process conditions;
- need for special welding procedures, or other jointing techniques;
- need for special inspections, tests, or quality control;
- possible misapplication during construction, operations and maintenance;
- need for performance in a fire situation.

2.1.2 Due to the specific field of applications (e.g. offshore installation with high-chloride concentration; hydrocarbon service with possible corrosion/erosion) special considerations are to be provided to the selection of material grade and manufacturing process. The following corrosion phenomena are to be considered:

- Uniform metal loss, pitting corrosion, corrosion-erosion (corrosion-erosion is defined in ISO 13703 Section 3.1 Terms and definitions *"eroding away of a protective film of corrosion product by the action of the process stream, exposing fresh metal which then corrodes")*;
- Sulfide stress-cracking: as defined in ISO 13703 Section 4.4.4 *"process streams containing water and hydrogen sulfide may cause sulfide stress-cracking of susceptible materials"*;
- Hydrogen-induced cracking: as defined in ISO 13703 Section 4.4.6 *"process streams containing water and hydrogen sulfide may*

cause hydrogen-induced cracking (HIC) of susceptible materials, particularly to carbon steel plate fabrications or pipe made from plate".

- Chloride stress-corrosion cracking: as defined in ISO 13703 Section 4.4.3 *"process streams that contain water with chlorides may cause cracking in susceptible materials[1], especially if oxygen is present and the temperature is above 60 °C".*

2.1.3 When corrosion-resistant alloys (CRAs) as defined in ISO 15156-1 Section 3 Terms and definitions *"alloy intended to be resistant to general and localized corrosion of oilfield environments that are corrosive to carbon steels"* are going to be applied, careful consideration is to be given to the following fabrication aspects:

- Pipes and components for corrosive environment are to be selected either from existing materials lists or on the basis of field experience and/or laboratory testing according to ISO 15156;
- Welding procedures are to be selected to not alter the corrosion resisting characteristics of the base material;
- The coupling with other alloys that are not compatible (e.g. for galvanic corrosion effects) is to be avoided.
- Some sulfide stress-cracking corrosion resisting alloys (i.e. some stainless steel grades) may be susceptible to chloride stress-corrosion cracking[1].

2.1.4 Other corrosion protection systems than corrosion resisting alloys such as: chemical treatment of the fluid, protective coatings, corrosion monitoring (coupons, probes, spools, etc.) may be considered. Adequate provisions are to be established by the Owner or the Designer and submitted to Tasneef for approval.

2.2 Selection on the basis of fluid service

2.2.1 The selection and application of materials, components, and joints is to be performed on the basis of fluid service.

2.2.2 Fluid service, according to ASME B31.3 300.2 Definitions, is *"a general term concerning the application of a piping system, considering the combination of fluid properties, operating conditions, and other factors that establish the basis for design of the piping system.".*

2.2.3 The list of piping materials reported in ASME B31.3 and ISO 15156 are to be applied depending on the fluid service of concern, as summarized in Table 1.

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[1] According to ISO 13703 Section 4.4.3 *"High alloy and stainless steels, such as the AISI 300-series austenitic stainless steels, precipitation-hardening stainless steels, and "A-286" (ASTM A 453 grade 660), are not to be used unless their suitability in the proposed environment has been adequately demonstrated".*

Fluid Service	Media	Pressure and/or temperature conditions	Materials
Fluid Service D	As defined in ASME B31.3 .-300.2-Definitions *"non-flammable, nontoxic, and not damaging to human tissues"*	105 kPa < p < 1035 kPa (150 psi) and −29°C < T < 186°C	All listed in ASME B31.3 Appendix A Pipes and components under severe cyclic conditions [a)] are to be selected from the lists in 305.2.3 and 306.1.4 of ASME B31.3 respectively
Fluid Service M	As defined in ASME B31.3 -300.2-Definitions *"a service in which the potential for personnel exposure is judged to be significant and in which a single exposure to a very small quantity of a toxic fluid, caused by leakage, can produce serious irreversible harm to persons on breathing or bodily contact, even when prompt restorative measures are taken"*	Whichever	All listed in ASME B31.3 Appendix A, except: Spiral-welded; ERW; Furnace Butt-Welded (ASTM A 53 Type F); Furnace lap-welded; ASTM A 134 made from other than ASTM A285 plate Admitted with safeguarding: ASTM A 134 made from ASTM A 285 plate; ASTM A 139 For pipes and components under severe cyclic conditions [a)] the Designer is to specify other necessary provisions (e.g. piping layout, component selection, etc.).
High Pressure Service K	Whichever	As defined in ASME B31.3 - K300 *"pressure in excess of that allowed by the ASME B16.5 Class 2500 rating for the specified design temperature and material group".*	All listed in ASME B31.3 Appendix K. Only seamless or longitudinally welded pipes with additional provisions for examination in K305 of ASME B 31.3 Only components according to K306 to K309 additional provisions for examination.
Normal Fluid Service	As defined in ASME B31.3 *"a fluid service not subject to the rules for Category D, Category M, or High Pressure Fluid Service";* excluding fluids that are non-flammable, non-toxic, and not damaging to human tissues with p < 105 kPa and −29°C < T < 186°C		All listed in ASME B31.3 Appendix A, except: Spiral-welded; ERW; Furnace Butt-Welded (ASTM A 53 Type F); Furnace lap-welded; ASTM A 134 made from other than ASTM A285 plate Admitted with safeguarding: ASTM A 134 made from ASTM A 285 plate; ASTM A 139 Pipes and components under severe cyclic conditions[a)] are to be selected from the lists in 305.2.3 and 306.1.4 of ASME B31.3 respectively
Corrosive Hydrocarbon Service	As defined in ISO 13703 Section 3.1 Terms and definitions *"service in which the process stream contains water or brine and carbon dioxide (CO_2), hydrogen sulfide (H_2S), oxygen (O_2) or other*	Whichever	Carbon and low-alloy steels resistive to sulfide stress-cracking in ISO 15156-2 Annex A CRAs and other alloys resistive to sulfide stress-cracking and chloride stress corrosion cracking in ISO 15156-3 Annex A Only seamless pipes. Longitudinal SAW

	corrosive agents under conditions which cause corrosion of metal"		pipe may be applied if specifications and quality control applicable to this service have been exercised in manufacturing in agreement with Tasneef (Annex B of ISO 3183). Additional provisions for pipe examination in accordance with Annex K of ISO 3183. Plates for fittings, flanges and other components: 100% ultrasonic testing according to ASTM A 578 Level C; for pipe fittings additional requirement S1.1.
Note: If effective fluid service fall in more than one class among those listed (e.g. Fluid Service M coupled with Corrosive Hydrocarbon Service) materials are to be selected matching the materials lists and the specific requirements of both classes. The most stringent requirement is to be adopted. [a)] Severe cyclic conditions (all fluid services except K) as defined in 300.2 of ASME B31.3.			

Table 1 - Fluid service requirements and applicable materials according to ASME B31.3 and ISO 15156.

2.2.4 If High Pressure Service K is of concern specific attention is to be given to the manufacturing process to ensure uniformity of properties throughout each piping component. Additional provisions for examination are to be in accordance with K305 through K309 of ASME B31.3.

If Corrosive Hydrocarbon Service is of concern additional provisions are to be applied:

- Pipe manufacturing procedure qualification according to Annex B of ISO 3183;
- Pipe examination in accordance with Annex K ISO 3183;
- Plates for fittings, flanges and other components: 100% ultrasonic testing according to ASTM A 578 Level C; for pipe fittings additional requirement S1.1.
- Additional requirements for corrosive hydrocarbon fluid service are specified in Section 0 and 0 of this Chapter according to ISO 15156.

2.2.5 Other materials recognised by national or international standards although not listed in [2.2.3] may be used in process piping systems on offshore production platforms provided that the Manufacturer proves the proposed product is suitable for the intended fluid service requirements, by submitting to Tasneef the relevant documentation, with special consideration of the minimum inspections and relevant requirements reported in these Rules.

2.2.6 The manufacturer is to establish and follow documented procedures for maintaining the heat identity and the test-unit identity for all such pipes and components. Such procedures are to provide means for tracing any length of pipe to the proper test unit and the related chemical and mechanical test results.

2.2.7 Supply conditions of pipes and components are to be specified by the Owner and the Designer.

2.2.8 It is the ultimate responsibility of the Owner and the Designer to select and specify, in agreement with Tasneef, additional requirements or more stringen t acceptance criteria, if applicable.

3 Acceptance criteria

3.1 General

3.1.1 Acceptance criteria for chemistry, physical and mechanical properties, method and process of manufacture, heat treatment, quality control etc. are to comply with the relevant material standard (see Table 1) and the additional requirements in Table A-1 or Table K-1 of ASME B31.3 as appropriate for the fluid service requirements.

3.1.2 Materials not listed in the above Table 1 may be used provided they conform to a published specification covering chemistry, physical and mechanical properties, method and process of manufacture, heat treatment, and quality control, and otherwise meet the requirements of these Rules.

3.1.3 Additional requirements for corrosive hydrocarbon fluid service are specified in Section 0 and 0 of this Chapter in accordance with ISO 15156.

3.2 Chemical composition

3.2.1 If High Pressure Service K is of concern conformance of materials to the product analysis chemical requirements of the applicable specifications are to be verified, and certifications are to be supplied. Requirements for product analysis are defined in the applicable materials specification.

3.2.2 Tolerances of chemical composition regarding composition of heat analysis and/or product analysis are to comply with the applicable international standards or other standards recognised by Tasneef.

3.3 Mechanical properties

3.3.1 Basic allowable stresses (S) in tension listed in Table A-1 or Table K-1 of ASME B31.3 as appropriate for the fluid service requirements are to be used in design calculations.

3.3.2 Materials not listed in the above tables may be used provided that the basic allowable stresses (S) in tension are established as stated in section 302.3.2 or K302 of ASME B31.3 as appropriate for the fluid service requirements.

3.3.3 If High Pressure Service K is of concern the upper temperature limit is to be less than the temperature for which an allowable stress is governed by the creep or stress rupture.

3.3.4 If additional tensile properties are required to be determined at temperature other than those reported in Table A-1 or Table K-1 as appropriate, the acceptance criteria are to be in accordance with ASME B31.3 and agreed with Tasneef.

3.3.5 To ensure adequate resistance to brittle fracture, the selected material grade is to have adequate notch toughness at the design thickness and design temperature combination.

3.3.6 Additional requirements of CVN impact properties are to be in accordance with ASME B31.3. In particular minimum temperature reported in Table A-1 (or Table K-1 for High Pressure Service) of ASME B31.3 defines the limits between two levels of toughness requirements as reported in Table 323.3.1 (or Table K323.3.1 for High Pressure Service) of ASME B31.3.

3.3.7 If corrosive hydrocarbon service is of concern the hardness in the pipe body, weld and HAZ are to be in accordance with ISO 15156-2 Table A.1 for carbon and low alloy steels.

3.3.8 The Owner or the Designer is to consider applying more stringent hardness limits for pipes and fitting subjected to fabrication process (e.g. circumferential welding, hot or cold forming) that may affect the microstructure characteristics in order to ensure that the hardness limit of 250 HV10 is respected on the finally assembled piping system.

3.3.9 If corrosive hydrocarbon service is of concern, CTOD test are required: an assessment of minimum requirements needed for the intended service conditions is to be performed by the Owner and the Designer in agreement with Tasneef.

3.4 General corrosion (uniform corrosion, corrosion-erosion)

3.4.1 In determining the minimum required thickness of a piping component, allowances are to be included for uniform corrosion and corrosion-erosion according to ISO 13703.

3.4.2 Corrosivity predictions are very qualitative and may be unique for each system. General corrosivity information in gaseous production streams can be found in ISO 13703 Table 1.

ISO 13703 Table 1 is intended only as a general guide for corrosion mitigation considerations and not for specific corrosivity predictions.

3.4.3 Sizing methods and criteria are to be in accordance with ISO 13703 Section 5, taking into account flow regime and velocity for the evaluation of the corrosion allowance.

3.5 Corrosion in hydrocarbon service

3.5.1 Qualification of materials for corrosive hydrocarbon service is to be performed according to ISO 15156.

3.5.2 The Owner and the Designer have to define, evaluate and document the service conditions to which materials can be exposed for each application with particular attention to those factors known to affect the susceptibility of materials to cracking caused by H_2S, according to ISO 15156-1 Section 6.

3.5.3 The materials suitable for the application in corrosive hydrocarbon service can be selected either from existing materials lists (Table 1) or on the basis of field experience and/or laboratory testing according to Section 8 of ISO 15156-1.

3.5.4 Method of selection is to be documented in accordance with Section 9 of ISO 15156-1.

3.5.5 The test method and requirements for qualifying and selecting materials for corrosive hydrocarbon service by laboratory testing are to be in accordance with Annex B of ISO 15156-2, as complemented by NACE TM0177 and NACE TM0284 test methods.

4 Piping components dimensions and ratings

4.1.1 Dimensions and ratings of components (fitting, flange, gasket, bolting, etc.) are to be in accordance with standards listed in Table 326.1 (and Table K326.1 for High Pressure service) of ASME B31.3.

4.1.2 Other dimensional requirements stated in the selected material standard (ref. Table 1) are to be complied with.

4.1.3 The ratings of components from Table 326.1 (and Table K326.1 for High Pressure service) of ASME B31.3 are accepted for pressure design in accordance with ASME B31.3.

5 Inspection and reports

5.1.1 Piping classification is to be the base for defining inspection and documentation of material quality and testing.

5.1.2 The pipes and components used in piping systems are to be provided with the documentation outlined in Table 2, depending on fluid service requirements:

Fluid Category	**Documentation**
Fluid Service D	Test Report according to Section 2.2 of ISO 10474
Fluid Service Normal	Inspection certificate (Works Certificate) according to Section 3.1 of ISO 10474
Fluid Service M, K and Corrosive Hydrocarbon Service	Inspection certificate (Test Certificate) according to Section 3.2 of ISO 10474

Table 2 - Definition of types of documentation of material quality and testing according to ISO 10474.

5.1.3 Batch composition and frequency of inspections are to be in accordance with the relevant product standard, unless more stringent criteria are reported in these Rules.

PART D CHAPTER 3

STRUCTURE FABRICATION

1 Fabrication Requirements

1.1 General requirements

1.1.1 Structure fabrication is to be performed in accordance with ISO-19902 (ref. section 20) and the therein referenced standards.

1.1.2 ISO-19902 requirements are to be considered as minimum requirements and complemented or amended by these Rules as specified and detailed in this Chapter. The Owner, the Designer or the Manufacturer have the option to adopt different standards or requirements provided that they are demonstrated to be equivalent or fit for the working conditions and proposed to Tasneef for review and approval.

1.1.3 The requirements of this Chapter are provided to cover the fabrication of the structure of a new platform or other pre-service conditions as applicable, as well as any work to be carried out for reassessment, removal or reuse of an existing platform, to the extent that relevant arrangements, modifications or repairs are affecting the original features of the structure.

1.1.4 Fabrication records are to be filed as appropriate for the classification or certification of new structure or for the purpose of assessment of existing structures, in compliance with the applicable requirements of these Rules.

1.1.5 Fabrication records completed in accordance with other internationally recognized standards are evaluated by Tasneef on the basis of their equivalence with these Rules. Deviations from the Rules are considered by Tasneef on the basis of documented engineering justifications provided by the Owner, the Designer or the Manufacturer. Final proof of structural integrity and fitness-for-purpose and expected life is the base for approval.

1.1.6 According to ISO-19902:2007, for appropriate definition of requirements with regards to material, fabrication, welding and weld inspection, the Owner or the Designer is to select either the “material category” or the “design class” approach.

Minimum requirements are to be considered with reference to those indicated in ISO 19902:2007, Annexes C, D, E and F, as applicable.

The selection is to be reflected on the detailed design documentation, i.e. drawings and specifications.

1.1.7 A set of detailed specifications covering the main processes of the fabrication and of relevant inspections and testing is to be submitted to Tasneef for approval.

Fabrication and inspections are to be performed according to procedures fully compliant with the above-mentioned specifications.

1.1.8 Deviations from these Rules are to be submitted to Tasneef for review and approval. Possible deficiencies or defects exceeding the acceptance level prescribed by the reference standards are to be removed or repaired according to written procedures submitted to Tasneef review and approvals.

1.1.9 During construction a documented system for identifying the materials and for assuring material traceability is to be applied.

1.1.10 Material traceability procedure is to be approved by Tasneef and to provide that all materials are identified by permanent marking and traceability is documented and verified with material test certificates and as built records.

1.1.11 Materials having defects exceeding the specified limits may be used only if the defects are removed or repaired with appropriate procedures and to the satisfaction of Tasneef. Repair results are to be recorded and traceable in the as built records

1.1.12 During material receive, storage, handling, construction and assembly due precautions are to be taken to prevent contamination, corrosion and damaging of structural steel surfaces, dimensional characteristics (e.g. roundness, end squareness) and prepared bevelled ends if applicable.

1.1.13 Storage, fabrication and welding activities are to be performed in dedicated areas. Materials are to be protected as far as practical from atmospheric agents, from contamination and from detrimental conditions.

1.1.14 In case that restraint conditions in the thickness direction are generated by welding, relevant structural components’ material is to have appropriate characteristics in through thickness direction.

1.1.15 During construction, assembly and handling of the structures, the loads that may be transmitted from support structures, lifting equipment etc., are to be taken into consideration.

1.1.16 Dimensions of connecting welding shall not be smaller or greater than those specified by approved construction drawings, unless prior approval is obtained from Tasneef

1.1.17 Temporary attachments installation and removal are to be controlled in accordance with requirements of ISO-19902:2007, Clause 20.4.2.3.

1.1.18 Fillet welds utilised to join attachments to structural materials are to be continuous and countered when necessary to provide a continuous sealing function in addition to the structural function.

1.1.19 No welding to join either temporary or permanent attachments is allowed on cold formed material, on forged and cast materials (except bevelled ends) unless the activity is covered by a procedure approved by the Tasneef surveyor.

2 Material Preparation

2.1 Base material preparation

2.1.1 Plates are to be flame-cut, using automatic cutting equipment when necessary. Plasma cut or cold cut are acceptable alternative. Shear-cut may be accepted for small thicknesses.

2.1.2 The cut edges are to be free from injurious defects and free from oxides and from any cut residuals. Defects, if any, are to be removed by mechanical processes.

2.1.3 Heat affected zone produced by flame or plasma cut is to be removed by grinding or machining from weld bevels and from all surfaces to be welded. Non-destructive testing of the cut edges (e.g. magnetic or dye penetrant) and of adjacent areas (ultrasonic) may be required to confirm absence of lamination for important structural parts and/or for heavy thickness (e.g. 25 mm and above). Repair procedures for areas to be repaired and associated tests are to be agreed with the Tasneef Surveyor.

2.2 Forming

2.2.1 The Designer or the Manufacturer is to submit the specification of forming and any related heat treatment procedures for Tasneef approval. These documents are to be in accordance with the requirements of ISO 19902:2007 Clause 20.4.3 and are to demonstrate that the original material properties are maintained after the forming is completed. Forming requirements are to consider the original plate lamination direction in order to ensure that major stresses applied during the structure life are oriented in the most favourable direction.

2.2.2 Qualification of the forming procedure is to be done prior any forming activity is started. Qualification is to cover all essential variables and the qualified ranges including as minimum but not necessarily limited to: fabricator and workshop, material type and grade, manufacturing process (e.g. normalized, thermo-mechanically rolled), mechanical properties (including toughness and through the thickness tensile), thickness, diameter to thickness ratio, maximum total deformation, maximum deformation for each pass, forming speed, minimum and maximum temperature, time of permanence at critical temperatures, final forming temperature, re-rolling, post-forming treatment, longitudinal welding and any connected post weld heat treatment as applicable.

2.2.3 Trial tests and mechanical testing to demonstrate mechanical properties are to be performed as required by ISO 19902 or as additionally required by Tasneef.

2.2.4 The following prescriptions are to be considered as indicative minimum requirements by the Designer or the Manufacturer which may propose equivalent alternative requirements for Tasneef review and approval:

- cold forming (ambient T below 200C) can be performed when the maximum deformation of fibres does not exceeds 5% for SMYS up to MPa 275 included
- cold forming when the maximum deformation of fibres exceeds 5% for Group I (SMYS up to MPa 275) included and 3% for higher strength steel is to be followed by stress relieving heat treatment. Alternatively strain ageing test results may be considered by Tasneef for approval
- hot forming on normalized steel may be carried out from 450C up to 800C. When forming temperature is above 600C the forming is to be followed by normalizing heat treatment in accordance with steel manufacturer recommendations;
- hot forming on thermo-mechanically formed steel may be carried out from 450C up to 600C provided the actual rolling temperature is confirmed suitable by the steel manufacturer
- re-rolling after longitudinal welding is not to exceed 5% or 3% as above specified of fibres deformation
- re-rolling and/or final heat treatment (including stress relieving treatment) are

to be covered as essential variables for the longitudinal and/or circumferential, if any, welds procedure qualification.

Note: maximum deformation of fibres is to be calculated as follows:

$$S = \frac{50 \cdot s}{r_m}$$

where “s” is the thickness, in mm, of the part considered and “r” is the radius of curvature (mm) of the part.

2.2.5 Steel manufacturer recommendations for hot forming and heat treatment are to be accounted as mandatory and any proposed deviation is to be submitted to Tasneef for approval.

3 Dimensional Tolerances

3.1 Dimensional tolerances for prefabricated structural members

3.1.1 Dimensional tolerances for prefabricated structural members are to be checked in accordance with a procedure compliant with design specification and drawings.

3.1.2 The procedure is to detail dimensional check stages, measuring procedure and tools and acceptance criteria to assure that local (i.e. prefabricated and pre-assembled components) and consequently global fabrication tolerances are respected.

3.1.2 The dimensional check procedure is to cover as minimum the following requirements:

- tubulars members: thickness, circumference, length, roundness, straightness, end squarness, joint mismatch;
- prefabricated nodes: length of the can, stub and reducer distance from theoretical working points, stub centreline offset with regards to theoretical working point, gap between adjacent weld toes;
- ring stiffeners: dimensions, position and inclination with respect to theoretical values;
- fabricated beams: thickness, local tolerances, out of straightness, verticality, positioning and dimensions of stiffeners and rat holes;
- miscellaneous: weld profiles, grout weld beads, cruciform joints, splices.

3.2 Dimensional tolerances of fabricated structures

3.2.1 Global fabrication tolerances (i.e. horizontal, vertical, straightness and alignment) are to comply as a minimum with requirements and recommendations of ISO 19902:2007, Clause 20.4.4 and Annex G.

3.2.2 The Owner, the Designer or the Manufacturer is to provide a comprehensive dimensional control specification demonstrating compliance with the above reference standard and covering as minimum the following:

- nodes: position measured as offset of the “actual” with respect to the “theoretical” working point indicated on the approved fabrication drawings, centreline of the brace at chord intersection, angular orientation of the brace/stub;
- legs: horizontal and diagonal leg spacing, alignment, straightness, thickness change location, joint mismatch;
- plan bracings: vertical tolerances;
- horizontal/diagonal bracings: final and overall length and straightness, thickness change location;
- conductor guides and pile sleeves: out of roundness and offset from theoretical and best-fit centre line;
- deck beams and columns: axes intersections and distances, working points and planes, verticality, planarity, elevation;
- anodes positioning;
- lifting pad-eyes: positioning, horizontal and diagonal spacing, angular orientation, verticality, working point;
- pedestals for cranes and lifting equipment;
- miscellaneous: conductors, piles, buoyancy tanks, caissons, risers, J-tubes.

4 Grouted connections

4.1 Pile to sleeve

4.1.1 Pile to sleeve connection to be grouted shall be in accordance with ISO 19902:2007, Clause 20.4.5.

5 Welded connections

5.1 General Requirements

5.1.1 The Owner or the Designer is to provide welding and weld inspection specifications for Tasneef review and approval.

5.1.2 Welding and weld inspection specifications are to be in accordance with ISO 19902 Section 20 “Welding, fabrication and weld inspection” requirements and particularly are to be in accordance with a selected international or national welding standard (see additional guidance in ISO 19902 Clause 20.2 and Appendix A.20.2). Selected welding standard is to be reviewed for applicability and approved by Tasneef.

5.1.3 The requirements for welding and weld inspection are to be in accordance with the selection done with regards to the “material category” or the “design class” approach (ref. ISO 19902:2007, Annexes C or D).

Consequently the minimum requirements are to be those indicated in ISO-19902: 2007, Section 20 supplemented by Annexes B and G for material testing and fabrication and Annexes E or F for welding and weld inspection.

The selection is to be reflected in the welding and weld inspection specifications, procedures and documentation.

5.1.4 ISO-19902 and selected welding standard requirements are to be considered as minimum requirements and complemented or amended by these Rules as specified and detailed in this Chapter. The Owner, the Designer and the Manufacturer have the option to adopt different requirements from the ones contained in ISO 19902:2007 or in these Rules provided they are demonstrated to be equivalent and/or fit for the working conditions and proposed to Tasneef for review and approval.

5.1.5 Assessment of existing structures’ welding records will be performed by Tasneef for compliance with the requirements of ISO 19902:2007 and these Rules. Welding and inspection records completed in accordance with other internationally recognized standards will be evaluated by Tasneef on the basis of their equivalence with these Rules. Deviations from these Rules will be considered by Tasneef on the base of documented engineering justifications provided by the Owner, the Designer or the Manufacturer. Final verification of material integrity and fitness-for-purpose is to be the base for approval.

5.1.6 Weld details are to be specified in the welding specification and/or in the selected standard and to be compliant with ISO 19902:2007 - Annex A.20.2.3.3 - Figure A.20.2.2. These requirements are to be considered as minimum requirements. Weld proximity requirements are to comply as minimum with ISO 19902:2007, Clause 20.4.2.2 and Figure 20.4.1.

Any deviation is to be proposed for Tasneef review and approval.

Additional or complementary requirements to be considered are detailed in the following paragraphs.

5.1.7 Welded tubular T-Y-K joints on components classified in Design Class 1, 2 and 3 or joints having different typology but having equivalent conditions (e.g. reduced redundancy level, geometrical complexity, multi-axial stress level) are to be of complete penetration type and whenever possible welded on both sides.

5.1.8 One-side welding may be accepted when back-weld is impracticable. In this case complete penetration welding procedure covering not back-welded root is to be utilised and complemented by non-destructive testing suitable to confirm complete penetration of the production welds and to satisfy weld acceptance criteria and dimension requirements (i.e. weld thickness) as defined in ISO 19902:2007, Appendix A20.2.3.3-Figure A.20.2.2.-Sections C-C and D-D.

Selected methods, extensions and acceptance criteria of non-destructive testing for one-side complete penetration welds are to be approved by Tasneef.

5.1.9 Provided that article 5.1.7 is satisfied, fillet welds or partial penetration welds are generally admitted on T-Y-K joints only if they are not tensile or bending stressed, except for reduced static stresses.

5.1.10 For butt-weld joints on plates or tubular of unequal thickness differing more than 3 mm for thicknesses up to 20 mm, and 4 mm for greater thicknesses, the thicker member is to be tapered to a slope of not less than 1:4. The thickness difference is to be calculated by adding the measured thickness difference plus the mismatch at root if any.

5.1.11 Adequate precautions are to be taken against lamellar tearing of cross fillet welds or T-Y-K joints that are under restraint conditions and/or where thicker element is of 25mm thickness or higher. Stub to can welded joints where can thickness is 25 mm or higher are to have weld foot print ultrasonically tested to confirm absence of segregation and lamination defects. Foot print width is to be equal or larger than the thickness of the thinner part + 25 mm each side.

5.1.12 Welded joints affected by severe fatigue stresses may be treated by weld improvement obtained by means of profile control and toe grinding. Profile control is to achieve requirements of ISO-19902:2007 Annex A.20.2.3.3-Figure A.20.2.2 as minimum. Toe grinding and profile control techniques and related inspection procedures are to be approved by Tasneef. Hammer peening is generally not allowed.

5.1.13 Environmental conditions are not to affect production welds. When necessary adequate protection shall be arranged for joints performed outdoor. Edges of joints are to be dry at the time of welding; moisture is to be removed by heating.

5.1.14 Procedures for preparation of edges and for positioning and assembling of parts are to be such that fit-up assures alignments, gaps and that final joints are in compliance with construction specifications and to the satisfaction of Tasneef Surveyors.

5.1.15 Positioning of parts is to be performed with auxiliary tack welds. Tack weld is to be appropriately performed by qualified welders using low-hydrogen covered electrodes. Tack weld performed as specified above may be melted in the joint weldment if this practice is covered by the qualified welding procedure and proven to be free from defects after adequate testing.

5.2 Welding processes

5.2.1 Welding processes specified in items (a) to (d) are admitted if approved for types that are appropriate to the joint categories. Other processes may be allowed at the discretion of Tasneef in compliance with conditions stipulated case by case.

a) Manual Metal Arc Welding processes with low hydrogen basic covered electrodes. These processes may be used for all types of joints and in all welding positions; they are to comply with the limits of H_2 content in deposited metal as specified in ISO 3690 (HDM 10 ml/100g or HDM 5 ml/100g as applicable);
b) Automatic submerged arc welding processes. These processes may be used in flat position for butt joints and T-joints, and in flat and horizontal position for fillet welds;
c) Automatic and semiautomatic gas metal arc and flux cored arc welding processes with shielding gas or cored wire arc welding without shielding gas. Unless otherwise stated, these processes using the "spray arc" technique are to be employed for the types of joints similar to those mentioned above for automatic submerged arc processes. Particular limits and additional inspections may be stipulated case by case;
d) Gas tungsten arc welding processes may be generally used for performing the first pass and hot pass as applicable of butt welds when root gap is lower than 3 mm, as an alternative to back weld for pipes or branches.

5.3 Welding consumables

5.3.1 Welding consumables compatible with the base material are to be used for welded joints in order to have mechanical properties that are not lower than those specified for the base material, unless otherwise approved by Tasneef.

5.3.2 Welding consumables classed in a grade with a tensile strength value greater than the grade of the base material are to be approved by Tasneef in each case.

5.3.3 Welding consumables for joints on base material having different properties are to comply with the requirements for the material having lower properties, unless otherwise approved.

5.3.4 Welding consumables are to be verified by Tasneef at the Manufacturer's works, in compliance with the adopted welding specification and the Rules. Manufacturer may propose for Tasneef acceptance different welding consumables if classed in compliance with equivalent recognised standards and manufactured by a recognised supplier having a certified quality management system.

5.3.5 Tasneef may request verification of specified properties for any welding consumables at any working stage, on each production lot or consumable batch/ heat or at fixed intervals.

5.3.6 Basic covered electrodes to be used for manual metal arc welding for joints classified in Design Class 1, 2 and 3 are to be certified with designation "H5" for hydrogen content on deposited metal in accordance with ISO 2560 or equivalent.

5.3.7 Welding consumables are to be certified for impact properties of all-weld-metal in accordance with the relevant applicable ISO standard (e.g. ISO 2560 for covered electrodes) or equivalent.

5.3.8 ISO standards requirements for impact properties are to be considered minimum requirements for consumable certification.

5.3.9 Additionally the impact properties are to be upgraded if required in order to match toughness requirements specified for the structural base metal in accordance with ISO 19902:2007 Table 19.4.1 and with the prescriptions deriving from the selection of either "material category" or "design class" approach (ISO 19902- Annexes C or D).

5.3.10 Welding consumables and in particular covered electrodes, fluxes and flux-cored wires are to be protected from moisture, contaminations and any adverse conditions during the whole receive, storage, handling, work site use cycle. When delivered from storekeeper to welders they are to be kept in suitable containers to prevent moisture or foreign substance contamination.

5.3.11 Welding consumables which are contaminated by moisture, grease, oil or other damaging substances cannot be used.

5.3.12 Storage, relocation and drying treatment procedures for welding consumables intended for use are to be submitted to Tasneef for approval.

5.3.13 Covered basic electrodes supplied by recognized manufacturer in vacuum pack may be utilised for special working conditions within the limits specified or recommended by the manufacturer and provided they are suitably certified. Tasneef may require validation tests to confirm hydrogen content on deposited metal.

5.4 Welding process qualifications

5.4.1 Welding procedure specifications including weld repair procedures are to be submitted to Tasneef for procedure qualification.

5.4.2 Prequalified procedures may be considered for acceptance by Tasneef provided compliance with the minimum requirements specified in this chapter is demonstrated and provided they are previously approved by an internationally recognized independent party. Complementary production tests as defined in [5.8] may be required by Tasneef to validate the prequalification.

5.4.3 The same criteria apply for the assessment of existing structures with the exception that records of production tests executed during construction may be utilised for the validation.

5.4.4 Welding procedure qualifications are to be performed in accordance with the approved welding specifications (ref. [5.1.1]) and with the selected welding standard. In any case the requirements specified by this chapter are to be considered as minimum requirements.

5.4.5 The Manufacturer is to supply welding procedures specifications in accordance with requirements specified in the selected welding standard and in the welding specification. Here below typical details to be provided and to be considered as minimum requirements:

a) type of base material (group number as defined by applicable code, type, grade, sub-grade and additional identifications related to additional properties and delivery conditions);

b) range of qualified thicknesses;

c) welding consumables to be used with the welding process, code identification according to the standard, trade name and specific properties;

d) type of joint, geometry, welding preparation and parameters (according to thickness) and associated tolerances;

e) welding positions;

e) electrical parameters (volt, ampere, travel speed, heat input) and electrodes size for each weld pass

e) any additional information like: type of shielding gas, gas flow, stick-out as applicable depending on the welding process

f) preheating, interpass and post-heating temperature and methods (as applicable);

g) post-weld heat treatments, associated cycles and procedures (as applicable).

5.4.6 The Manufacturer is to submit to Tasneef the specifications of repair procedures performed by welding with a detailed description of the procedure, including defect removal, preliminary inspections, thermal cycles, heat treatments, re-testing and any required additional information.

5.4.7 Welding procedure qualifications are to be performed in accordance with the approved welding specifications [5.1.1] and with the selected welding standard. In any case the requirements specified by this chapter are to be considered as minimum requirements.

Tests are to be performed in the presence of Tasneef Surveyors except in case of prequalified welding procedure specifications as defined in [5.4.2].

Additional essential variables are to be considered in accordance with ISO 19902:2007 Clause 20.2.2 and related additional testing are to be performed.

5.4.8 The base material used in for the welding procedure qualification may be limiting the applicable range of qualified material beyond what specified by the selected welding standard in the following cases:

1. Yield strength of qualification material shall limit the yield strength of the qualified material

2. Carbon equivalent of qualification material is to limit the carbon equivalent of qualified material when hardness, toughness (impact tests or CTOD), or any combination, characteristics are specified. Minimum requirements are as specified in ISO 19902 Clause 20.2.2 but actual

cases are to be submitted for Tasneef approval.

5.4.9 Additional essential variables are to be considered when hardness, toughness (impact tests or CTOD), or any combination, characteristics are specified. Minimum requirements are as specified in ISO 19902 Clause 20.2.2 but actual cases are to be submitted for Tasneef approval.

5.4.10 Non-destructive and mechanical tests to be performed on welding procedure qualification specimens are to comply with the selected standard and acceptance to be performed in accordance with ISO 19902 Clause 20.2.2. In addition, the following requirements are to apply:

a) Non-destructive tests are to be performed by personnel qualified in accordance with an international qualification scheme recognized by Tasneef;

b) Welding procedure qualification specimens are to demonstrate absence of detectable defects;

c) Mechanical tests are to be performed in laboratories qualified by organisations recognised by Tasneef;

5.4.11 Qualification is valid only for the workshop/yard for which it was qualified or within the Manufacturer's different workshops/yards provided they are controlled by the same quality management system unless otherwise allowed by Tasneef for particular cases.

Validity of qualification lasts two years. This limit may be extended if the procedure is continually applied and if production tests as specified in [5.8] are performed.

When the parameters are modified but they remain within the limits specified in [5.4.12] for essential variables, the process qualification tests need not to be repeated.

5.4.12 In general qualification ranges of welding variables as specified by the welding specification and/or by the selected standard are acceptable. New welding process qualification or validation (partial retesting) may be required by Tasneef when any of the following variables are modified:

a) **Base material**: changes in steel type, grade, chemical composition and delivery conditions (with the exception of those variations which are considered by Tasneef as not significantly affecting the weldability and the mechanical characteristics of welded joints);

b) **Thickness**: changes in thickness exceeding the limits specified below:

s ± 25%, when s ˜˜20

s ± 40%, but not more than ± 20 mm, when s > 20

where s is the thickness, in mm, of the specimens used for qualification tests.

The above-mentioned limits are s ± 10% for automatic processes of single pass on both sides, for any thickness s of the pieces used for the qualification tests.

c) **Diameter of pipes**: changes in outside diameter from values greater than 300 mm to values smaller than or equal to 300 mm and vice versa.

d) **Edge preparation**: a decrease in included angle of the groove or an increase greater than or equal to 15° as compared to the included angle used in qualification testing. Significant variations of root opening and/or root face of the groove.

e) **Types of joint and welding procedure**:

1) change from butt welds to T-joints and vice versa;

2) change in welding from both sides to one side only;

3) the omission but not the inclusion of back gouging;

4) from partial penetration joint to complete penetration joint (not vice versa);

5) change from normal joints to tubular joints (cruciform joints etc.).

f) **Welding process**: any change.

g) **Welding consumables**: any change; for variations of approved welding consumables that belong to the same type of approval, Tasneef may limit qualification re-testing to operational tests and to one test for the check of mechanical properties.

h) **Welding positions**: change of one or more welding positions

i) **Welding parameters**: a change of more than 10% above or below the intensity of mean current, mean voltage and welding speed.

i) **Heat Input:** any decrease when hardness characteristics are specified and any increase when toughness characteristics are specified.

j) **Shielding gas**: a change in shielding gas from one particular single gas to any other single gas or to a mixture of gases, or a change in the specific nominal percentage composition of the gas mixture. A change of more than 10% above or below in the rate of flow of shielding gas or mixture.

k) **Preheating and interpass temperature**: a decrease of more than 15°C in minimum preheating temperature and/or a change of more than 50°C above or below in maximum interpass temperature.

l) **Stress-relieving heat treatment**: changes exceeding the normal range of temperature and rates, heating and/or cooling phase temperature gradients.

5.5 Qualification of welders

5.5.1 Welders to be used for welded joints with manual process and covered electrodes, with semiautomatic gas shielded process and with tungsten inert gas process are to be approved by Tasneef on the base of existing and in course of validity qualification released by a recognized independent body in accordance with the welding specification or selected standard.

5.5.2 Generally, welders to be used in production are to be qualified for all welding positions. Nevertheless, welders may be qualified for single positions if, in the opinion of Tasneef surveyor, they can be employed in production practically and safely. Recommendations provided in ISO 19902:2007, Appendix A.20.2.3.2 are to be also taken in consideration.

5.5.3 Regardless of the validity established by the selected standard Tasneef reserves the option to consider the welder qualification tests valid for two years from the date of testing and only if welders have documented working continuity not interrupted for more than 3 months.

5.5.4 Welder working continuity is to be recorded together with the results of non-destructive tests of the joints performed by each welder; these records are to be available for Tasneef Surveyors.

5.5.5 All weldments are to be stamped and recorded together with the results of non-destructive tests, and they are to be available for Tasneef Surveyors.

5.5.6 Welders used for tack welds that are not removed but are melted in the welding are to be qualified accordingly.

5.6 Preheating

5.6.1 Preheating is to be performed according to the thickness and to the carbon equivalent C_{EQ} content and calculated as specified by either the welding specification or the selected standard. The base material is to be uniformly heated at the specified temperature for a strip wide 2 times the highest thickness of the joint or at least 50 mm whichever is the lesser. Tasneef may require different values in particular cases (e.g. extreme weather conditions).

Preheating is to be performed in compliance with procedures deemed adequate by Tasneef.

5.6.2 Preheating temperature is to be measured before starting of welding and monitored during the welding execution on the portion of weld bevel not yet affected by welding. Preheating temperature applies to root pass execution and also to any subsequent bead. It is to be reinstated after welding interruption if any.

5.6.3 The inter-pass temperature is not to differ by more than ±50°C from approved qualification temperature, it is not to be greater than 250°C, nor is to be smaller than approved preheating temperature.

5.6.4 Preheating temperature is to be measured by suitable method and calibrated temperature measuring gauge. Measuring method and gauge are to be approved by Tasneef surveyor.

5.7 Post Weld Heat treatment

5.7.1 Specifications for post weld heat treatment as well as operating procedures are to be submitted to Tasneef for review and approval.

5.7.2 Equipment used for heat treatment is to be appropriate and is to have apparatus for recording temperature with tolerance within ±15°C. The temperature of the complete surface to be heat treated is to be measured and recorded in order to verify heat treatment uniformity.

5.7.3 The maximum temperature difference between outside and inside surface during treatment is to be measured or demonstrated not to exceed 30°C.

5.7.4 Temperature gradients in heating and cooling phases are to be appropriate for the steel type and for the size and geometry of the piece to be heat treated.

5.7.5 Where possible, heat treatment is to be performed in a closed furnace. Procedures and conditions for local heat treatment are to be submitted to Tasneef for preliminary examination. Generally a region with minimum extension equal to 3 times the joint thickness on each side of the joint is to be heated to the specified soaking temperature.

5.7.6 Stress relieving heat treatment is generally required for welded joints of special structures having thickness greater than or equal to 50 mm.

The above mentioned treatment may be required by Tasneef for joints of pieces having complex geometry or in pieces subjected to high stress conditions even if thickness is smaller than 50 mm.

When joints involve materials of unequal thickness, the greatest thickness is to be considered in order to establish heat treatment requirements.

Tasneef may consider waiving or reducing post weld heat treatment requirements if the Owner or Manufacturer provides documented justification and proven previous experiences demonstrating for a particular material no need for treatment.

5.7.7 Post weld heat treatment of structural steels specified in these Rules is to be performed at a temperature recommended for the material either by the applicable product standard or by the steel manufacturer.

5.7.8 Post weld heat treatment temperature and duration is to be determined taking into account steel manufacturing process and particularly heat treatments and temperature of final rolling. Special considerations are to be paid for thermo -mechanically rolled and quenched and tempered materials as well as when additional characteristics are specified (e.g. toughness and hardness) in order to ensure that originally designed mechanical properties are maintained.

5.7.9 Post weld heat treatment is to be considered an essential variable of the welding procedure specification qualification including all treatment variables like soaking time, temperature and possible repeated treatments (i.e. overall treatment duration).

5.8 Production tests

5.8.1 Production tests, representative of the joints welded in prefabrication and fabrication are requested to confirm mechanical properties of welded joints. The number of samples is to be based on the type of joint, type of material, thickness and importance of related structural elements.

Generally one specimen for each 100, 150 and 250 metres of welding is to be sampled covering either material category or design class as applicable. Generally one specimen for every 50 pieces is to be sampled for welded pipes, beams and other welded elements, unless otherwise required.

The specimens are to be, as far as practical, welded simultaneously with the joints that they represent and they are to be positioned at the ends of the joints and welded without interruption.

5.8.2 The material of the samples is to be representative of the material of associated structures and is to be identified by the steel manufacturer's data and by the rolling direction.

5.8.3 The type, number and arrangement of the production tests are to be specified by the Manufacturer and submitted to Tasneef for approval.

5.8.3 The above mentioned test specimens are to be mechanically tested and evaluated in compliance with the type and extension of tests required for the relevant welding procedure qualification.

5.9 Production welded joints

5.9.1 During fabrication and assembling of the structures, the welded joints are to be 100% visually examined and tested to the specified extension with non-destructive tests. Generally, non-destructive tests are to be performed 48 or 24 hours (depending on base material thickness and carbon equivalent) after welding of the joint. Shorter delayed time may be considered depending on base material thickness, welding parameters and geometrical constraint. When the part to be examined is to be post weld heat treated, non-destructive tests for weld joint acceptance are to be performed after such treatment.

5.9.2 The plan for non-destructive tests of steel structures is to be prepared by the Designer or the Manufacturer taking into account either the material category or the design class approach and submitted to Tasneef for approval.

5.9.3 Allowed tolerances are to be mentioned in an appropriate specification prepared by the Designer or the Manufacturer and submitted to Tasneef for approval.

5.9.4 Adequate tests to check for the presence of defects are to be performed by the Manufacturer during and after fabrication. The Manufacturer is to notify Tasneef Surveyors of any defects detected and to make arrangements for the removal of such defects.

5.10 Repairs

5.10.1 All injurious defects found during construction and assembly of the structures are to be repaired, within the limits of acceptability, with adequate procedures to the satisfaction of Tasneef Surveyors.

Repairs are to be performed before heat treatment for parts to be heat treated. Otherwise, heat treatment is to be repeated.

5.10.2 Repairs are to be carried out according to dedicated procedures and are to be approved by Tasneef Surveyors. Repair by welding is to be performed with electrodes having very low hydrogen content (designation “H5” for hydrogen content on deposited metal in accordance with ISO 2560 or equivalent), with qualified procedures and authorised welders.

Generally each weld repaired area is to be not shorter than 100 mm.

5.10.3 The repaired areas are to be submitted to visual examination and non-destructive tests to the satisfaction of Tasneef Surveyors. Non-destructive test method and specific technique to test the weld after repair is to be the same that detected the defect.

5.11 Weld joints inspection and testing

5.11.1 Each weld joint is to be inspected after completion and records of the completed inspection and relevant results are to be filled in and saved in a structured and traceable document management system.

5.11.2 The Owner or the Designer is to define examination extension and acceptance criteria in accordance with the selected welding standard or welding and weld inspection specification. Tasneef approval is to be obtained.

5.11.3 Welding and non-destructive inspection categories are to be determined as prescribed by ISO 19902:2007, Annex D, Table D7 and D8 as applicable.

5.11.4 Reference of minimum extension of non-destructive tests is to be set in accordance with ISO 19902:2007, either Annex E Table E.3 or Annex F Table F.2 as applicable.

Alternative examination extension may be proposed for Tasneef review and approval

5.11.5 Non-destructive testing acceptance criteria for weld joints are to be in accordance with the selected welding and fabrication standard as indicated in ISO 19902:2007, Annex A – A.20.2.1.

5.11.6 Any deviation, including upgrading, of acceptance criteria is to be provided to Tasneef for review and approval.

5.11.7 The Designer or the Manufacturer may propose the use of ultrasonic testing in lieu of radiographic testing when the last is specified. The proposal is to be supported by a documented demonstration of equivalence of the two methods for the specific application in terms of sensitivity and probability of detection. Acceptance criteria are to be also equivalent for the two methods or alternative criteria is to be proposed for ultrasonic testing in accordance with a recognized standard. The ultrasonic method is to be also qualified in accordance with a recognized standard when required by the selected welding standard and weld inspection specification. The replacement of radiographic testing with ultrasonic testing is to be approved by Tasneef.

5.11.8 Non-destructive testing is to be executed in compliance with dedicated procedures prepared as a minimum in accordance with the selected welding standard. Procedures are to be preliminary approved by an ISO 9712 Level 3 (or equivalent), qualified by demonstration of effectiveness and reliability and validated for the project via practical demonstration. Procedures, qualifications and validations are to be provided to Tasneef for review and approval.

5.11.9 Non-destructive testing is to be executed by qualified, experienced and recognized firms implementing a quality management system certified in accordance with an internationally or nationally recognized standard.

5.11.10 Non-destructive testing operators are to be qualified according to ISO 9712 or equivalent internationally or nationally recognized standard.

5.11.11 Generally non-destructive testing operators ISO 9712 Level 2 (or equivalent) are suitable for testing execution and evaluation of results.

5.11.12 Ultrasonic testing operators for T-K-Y joints of stub to can configuration require dedicated qualification (e.g. API RP 2X or equivalent).

5.11.13 Operators utilizing enhanced methods or techniques (e.g. phased array, TOFD) are to have the ISO 9712 (or equivalent) qualification extended to the specific method and technique.

5.11.14 In case non-conventional or enhanced methods or techniques are used, in case of complex testing or special joint criticality (e.g. severe acceptance criteria, complex geometry, material) and at discretion of the Tasneef surveyor the operator may be required to have its qualification validated for the specific procedure. Validation may be obtained via a theoretical and/or practical demonstration including equipment calibration, testing execution, detection-evaluation of flaws and final reporting.

5.11.15 Non-destructive testing activities are to be managed by a ISO 9712 Level 3 (or equivalent) who is to be responsible to approve non-destructive testing procedure, operators qualifications, examination results and in general to ensure and monitor the overall quality of the non-destructive testing activities and their compliance with the applicable specifications and standards.

5.11.16 Whenever extent is assigned in percentage less than 100% progressive examination is to be applied in accordance with an approved method. Criteria for selecting the sample is to ensure due coverage of welding procedure specification, welders, welding locations and production periods.

5.11.17 The following non-destructive testing methods are generally suitable to cover standard weld joint examination:

- Visual and dimensional inspection of weld surface and size;
- Magnetic and Penetrant testing for surface testing;
- Radiographic and Ultrasonic testing for volumetric testing.

The methods are usable and to be executed in accordance with prescriptions and limitations specified by ASME V for each method. Alternative recognized international or national standards may be considered by Tasneef for approval.

5.11.18 Non-destructive testing procedures are to be in accordance with the selected welding standard or welding and weld inspection specification. Tasneef approval is to be obtained

Additional requirements and limitations are specified in the following chapters.

5.11.19 Each weld joint is to be hard marked with its identification number. T-K-Y weld joints are to be hard marked during fit-up with reference lines to be placed at suitable and uniform distance from the weld root line. Reference hard marked lines are to be used as baseline for ultrasonic testing and for dimensional checks of the weld size.

5.11.20 Radiographic testing thickness and material limitations indicated by ASME V are to be considered as minimum requirements. Manufacturer is to demonstrate that for each radiographic technique the required values of density and sensitivity are consistently achieved and that the technique is effective in detecting all the type of flaws expected for the weld process.

5.11.21 Radiographic testing should be limited to thickness 38mm and lower for single wall exposure technique. Double wall exposure technique is to be further limited with regards to thickness and subjected to a satisfactory practical demonstration of the technique and related results.

5.11.22 Testing of higher thickness is to be considered only if executed in a complementary manner with other volumetric method i.e. ultrasonic testing.

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5.11.23 Ultrasonic testing on T-K-Y weld joint (typically stub to can) are to be executed in accordance with API RP 2X.

5.11.24 Ultrasonic testing (MUT, PAUT and TOFD) should be limited to thickness 12 mm and higher. Use of ultrasonic testing on lower thickness is to be subjected to a satisfactory practical demonstration of the technique and related results.

Authorization to the use of PAUT and TOFD is to be obtained via submittal of a dedicated procedure to be qualified by means of a qualification process approved by Tasneef.

5.12 Coordination of welding and inspection activities

5.12.1 The Manufacturer is to coordinate and control welding activities and the related inspection generally in accordance with ISO 14731 and ISO 3834 which is to be considered as minimum requirements.

5.12.2 Welding coordinators and inspectors are to be suitably qualified for the covered position and the assigned responsibilities. Qualifications are to be IWE, IWT, IWS as applicable.

5.12.3 Welding specifications, welding procedure specifications and qualifications, welders qualifications and other main welding documents are to be approved by the appointed IWE.

6 As Built Documentation

6.1 General requirements

6.1.1 The as built status of the steel structures is to be documented by means of an as built dossier prepared and controlled in accordance to an approved procedure.

6.1.2 As built dossier is to contain as a minimum:

- as built construction drawings;
- material test certificates and material traceability (base material and welding consumables);
- welding records including procedure qualifications, welder qualifications, weld joints traceability;
- dimensional checks reports;
- visual inspection records;
- non-destructive testing records;
- inspection test reports (various as applicable).

PART D CHAPTER 4

PIPING FABRICATION

1 Piping fabrication requirements

1.1 General requirements

1.1.1 Piping fabrication is to be performed in accordance with ISO-13703 and the therein referenced ASME B31.3.

1.1.2 ISO-13703 and ASME B31.3 requirements are to be considered as minimum requirements and complemented or amended by these Rules as specified and detailed in this Chapter. The Owner or the Designer has the option to adopt different standards or requirements provided they are demonstrated to be equivalent and proposed to Tasneef for review and approval.

1.1.3 Assessment of existing piping fabrication records is to be performed by Tasneef for compliance with the requirements of ISO-13703, ASME B31.3 and these Rules. Fabrication records completed in accordance with other internationally recognized standards are evaluated by Tasneef for their equivalence with these Rules. Deviations from these Rules are considered by Tasneef on the basis of documented engineering justifications provided by the Owner or the Designer. Final proof of material and plant integrity and fitness-for-purpose for the working conditions and expected life is to be the base for approval.

1.1.4 A set of detailed piping specifications covering the main fabrication processes and the relevant inspections and testing is to be submitted to Tasneef for approval. Fabrication and inspections are to be performed according to procedures fully compliant with the above mentioned specifications.

1.1.5 Deviations from these Rules are to be submitted to Tasneef for review and approval. Possible deficiencies or defects exceeding the acceptable standards are to be removed or repaired according to written procedures submitted to Tasneef review and approvals.

1.1.6 During construction, a system for identifying the materials and the components in order to assure material and components traceability is to be applied

1.1.7 Material and components traceability procedure is to be approved by Tasneef so as to provide that all materials and components are identified by permanent marking and traceability is documented and verified with material test certificates, components passports and as built records. Traceability and identification system is to preferably include colour marking which is to be extended to gaskets.

1.1.8 Material management and control procedure is to be adopted and submitted to Tasneef for review and approval.

1.1.9 Material and components having defects exceeding the specified limits may be used only if the defects are removed or repaired with appropriate procedures and to the satisfaction of Tasneef. Repair results are to be recorded and traceable in the as built records.

1.1.10 During material receive, storage, handling, construction and assembly due precautions are to be taken to prevent contamination, corrosion and damaging of piping and components surfaces, dimensional characteristics (e.g. roundness, end squareness) and prepared bevelled ends.

1.1.11 Storage, fabrication and welding activities performed on exotic materials (e.g. stainless steel, duplex, Ni base, alloys, copper, titanium and others) are to be done in areas segregated from other materials. Machining and other working tools are to be identified for the usability on the specific material and to be dedicated to that material.

1.1.12 Temporary attachments and supports installation and removal is to be done in accordance with approved construction drawings (typical) and selected materials that have to be compatible with the piping material. The activity is to be controlled by an approved procedure.

1.1.13 No welding to join either temporary or permanent attachments is allowed on cold formed material, on forged and cast materials (except bevelled ends) unless the activity is covered by an approved procedure and approved by the Tasneef surveyor.

1.1.14 Fillet welds utilised to join supports or doubling plates to piping and components are to be continuous and countered when necessary to provide a continuous sealing function.

1.2 Service Requirements

1.2.1 The Owner or the Designer in view of the actual fluid service design hypothesis is to provide a set of specifications and engineering details covering material selection, material requirements and testing, detailed design, fabrication requirements and specific inspection and testing requirements completed with the related acceptance criteria.

1.2.2 Piping lines with sour service requirements or potentially affected by stress corrosion cracking (e.g. chlorides) are to be designed, fabricated and tested in accordance with ISO-13703 and EN15156. ISO-13703 and EN15156 prescriptions are to be considered minimum requirements.

1.2.3 Sour service detail design is to include specific requirements for materials, fabrication, inspection and testing and is to be provided to Tasneef for review and approval.

2 Material preparation and selection

2.1 Base material preparation

2.1.1 In case pipe ends are to be cut for length adjustment or for bevelling the cold cut or flame-cut method using automatic cutting equipment are to be used. The cut edges are to be free from injurious defects and free from oxides and from any cut residuals. Defects, if any, are to be removed by mechanical processes. Heat affected zone produced by flame-cut is to be removed by grinding or machining from weld bevels and from all surfaces to be welded. Non-destructive tests of the cut edges and of adjacent areas may be required to confirm absence of lamination for heavy thickness (e.g.25 mm and above). Base material and bevel repair is generally not allowed. In particular cases the Manufacturer may submit procedures for areas to be repaired and associated tests are to be agreed with the Tasneef Surveyor.

2.1.2 Butt weld fitting bevelled ends shall not be cut or modified unless approved by the Tasneef surveyor.

2.1.3 Pipe, butt weld fittings and components beveled ends are to be adjusted as necessary by grinding or machining. Difference in thickness with adjoining components is to be adjusted by tapering the thicker components to a slope of not less than 1:4.

2.1.4 Bevels and near surfaces are to be cleaned before welding to remove any grease, oil, dirt, scale, rust, low melting point materials and any other contaminants that may affect the weld execution or the final quality of the welds.

2.2 Pipe fittings and flanges

2.2.1 Pipe elbows (e.g. 45, 90, 180 degrees) and pipe fittings (e.g. concentric/eccentric reducers, caps, straight/reducing TEEs and crosses) of diameter 1/2“ and above are to be procured from recognized suppliers and manufactured in accordance with the standards indicated by the approved piping specification.

2.2.2 Pipe bending, either cold or hot, is not allowed unless for tubing.

2.2.3 Pipe elbows cannot be fabricated by welding and splicing of elbows to obtain lower decree elbow is not allowed.

2.2.4 Flanges and hubs sealing faces are to be preserved during storage and fabrication by means of hard protections combined with corrosion prevention measures and products. Sealing faces and ring joint groove are to be checked before installation and before joint assembly in order to assure final joint integrity.

2.3 Welded branches

2.3.1 Branch connections and outlets are to be of the fully penetrated welded type (i.e. weldolets, sweepolets) and fabricated and installed in accordance with ASME B31.3. Weld beads are to fill the weld theoretical volume and the weld cap is to form a smooth profile with the adjoining parent metal surfaces.

2.3.2 Socket joints may be utilised for utilities limited to low pressure rating and non-critical services.

2.3.3 Socket joints are not allowed for sour service and services where crevice corrosion may occur.

2.4 Gaskets

2.4.1 Gaskets type and materials are to be selected on the base of the pressure rating and process service as specified in the selected design standard or specification. Hardness characteristics are to be defined to ensure compatibility with minimum hardness of the mating flanges.

2.4.2 Colour coding is to be used to ensure traceability.

2.4.3 Reuse of gaskets is to be generally limited to installation and testing phases and new gaskets are to be used for final joint assembly.

2.5 Bolted connections

2.5.1 Bolt type and materials are to be selected in accordance with the design standard.

2.5.2 Bolt tightening is to be covered by a specification defining the tightening method (manual torqueing, hydraulic torqueing, tensioning) with reference to piping class, pressure rating and flange sizes.

2.5.3 Activities are to be performed in accordance with an approved procedure ensuring joint integrity through tightening traceability and records.

3 Dimensional Tolerances

3.1 General requirements

3.1.1 Dimensional tolerances are to be checked in accordance with a procedure compliant with design specification and drawings. The procedure is to detail dimensional check stages to assure that both local and overall final fabrication tolerances are respected. Dimensional checks are to include as a minimum requirements of ASME B31.3 and particularly linear dimensions, angularity, orientation and planarity of flanges as well as final flanges alignment. Flange alignment is to assure that flanged joints can be tightened without introducing stresses on adjoining piping.

4 Welded Connections

4.1 General requirements

4.1.1 Owner shall provide welding and weld inspection specifications for Tasneef review and approval.

4.1.2 Welding and weld inspection specifications are to be in accordance with ISO-13703 and the therein specified ASME B31.3 and related ASME IX requirements

4.1.3 ASME B31.3 and ASME IX are to be considered as minimum requirements and complemented or amended by these Rules as specified and detailed in this Chapter. The Owner, the Designer or the Manufacturer has the option to adopt different internationally recognized or national standards provided they are demonstrated to be equivalent and proposed to Tasneef for review and approval.

4.1.4 Assessment of existing piping fabrication records will be performed by Tasneef for compliance with the requirements of ISO-13703, the therein specified ASME B31.3, the related ASME IX and the Rules. Welding and inspection records completed in accordance with other internationally recognized or national standards will be evaluated by Tasneef on the base of their equivalence with these Rules. Deviations from these Rules will be considered by Tasneef on the basis of documented engineering justifications provided by the Owner or by the Manufacturer. Final verification of material integrity and fitness-for-service and expected life will be the base for approval.

4.1.5 Butt full penetration welds are to be used for process piping.

4.1.6 Weld details and weld joint geometry requirements are to comply as minimum with ASME B31.3.

4.1.7 For butt-weld joints on pipes and fittings of unequal thickness the thicker member is to be tapered to a slope of not less than 1:4 providing that the inside diameter is equal and high-low is avoided in the root region.

4.1.8 Outlet hole in the main pipe at branch connection is to be made or at least finished by mechanical machining in order to ensure correct fit-up with adjoining weld-o-let.

4.1.9 Environmental conditions are not to affect production welds. When necessary adequate protection shall be arranged for joints performed outdoor. Edges of joints are to be dry at the time of welding; regardless of preheat requirements the moisture is to be always removed by heating. Preheating is always required when metal temperature is below 5° C. Welding at ambient temperature below 5° C is permitted only if covered by a specifically qualified procedure including a mandatory sheltering of the weld location as well as preheating application and monitoring regardless of material type/thickness and welding process.

4.1.10 Procedures for preparation of edges and for piping fit up are to be such that alignments, root gap and final joint geometry are in compliance with piping specifications and to the satisfaction of Tasneef Surveyors.

Tack weld is allowed only if appropriately performed by qualified welders using manual metal arc welding (low-hydrogen covered electrodes) or gas tungsten arc welding process. Tack weld performed as specified above may be melted in the joint weldment if this practice is covered by the qualified welding procedure and proven to be free from defects after adequate testing.

4.2 Welding processes and associated welding consumables

4.2.1 Welding processes specified in items (a) to (d) are admitted if approved for the joint categories. Other processes may be allowed at the discretion of Tasneef in compliance with conditions stipulated case by case.

a) Manual metal arc welding processes with low-hydrogen covered electrodes. The process may be used for all types of joints and in all welding positions, for C-Mn steel and for exotic material;
b) Automatic submerged arc welding processes. The process may be used in flat position for butt joints and T-joints (adequately positioned) and in flat and horizontal position for fillet welds. The process may be generally used for C-Mn steel and for exotic material;
c) Automatic and semiautomatic metal arc and flux cored arc welding processes with shielding gas and flux cored arc welding without shielding gas. Unless otherwise stated, these processes are to be employed using the "spray arc" technique and can be used for the types of joints similar to those mentioned above for automatic submerged arc processes. Use limitations with regards to base material and additional inspections may be stipulated case by case;
d) Gas tungsten arc welding process generally used for performing the first pass (and hot pass if applicable) of butt welds when back welding is not practical for pipe or branches. The process may be also used for completing welding in low thickness piping and components in exotic materials. The process may be generally used for for C-Mn steel and for exotic material.

4.2.2 Electrodes for manual metal arc welding are to comply with the limits of H_2 content in deposited metal. In general for normal and high strength steel covered low hydrogen type (ISO 3690 – HDM 10 ml/100g) is to be used while for very high strength steel and for weld geometry where high restraint is expected the extra low hydrogen type (ISO 3690 – HDM 5 ml/100g) is to be used.

4.2.3 Electrodes and filler wires for austenitic stainless steel, nickel base alloys and duplex/superduplex materials are to have suitable enhanced alloy chemical analysis and specific restrictions with regards to S and P.

4.2.4 Electrodes and filler wires for sour service piping systems are to have enhanced chemical analysis producing a deposited weld metal with controlled Ni content and specified hardness values.

4.2.5 Welding consumable are to be individually marked, supplied in manufacturer’s sealed packing and supported by material test certificate issued by the manufacturer. Consumable certificates may be ISO 10474 either type3.1 or type 3.2 depending on the material and fluid service criticality. Manufacturer welding specification and selected welding standard are to define type of certificate for each consumable category.

4.2.6 Welding consumables compatible with the base material are to be used for welded joints in order to obtain mechanical (including additional mechanical like toughness and hardness) and corrosion resistant properties that are not lower than those specified for the base material, unless otherwise approved by Tasneef

4.2.7 Welding consumables classed in a grade with a tensile strength value greater than the grade of the base material are to be approved by Tasneef in each case.

4.2.8 Welding consumables for joints made of base material having different tensile properties are to comply with the requirements for the material having lower properties, unless otherwise approved by Tasneef.

4.2.9 Welding consumables are to be approved by Tasneef at the Manufacturer's works, in compliance with the adopted welding specification and the Rules and with the qualified WPSs. Manufacturer may propose for Tasneef acceptance different welding consumables if classed in compliance with equivalent recognised standards and manufactured by a supplier having a certified quality management system. Tasneef may request verification of specified properties for all welding consumables at any working stage, on each production or lot or at fixed interval.

4.2.10 Welding consumables and in particular coated electrodes, fluxes and flux-cored wires are to be protected from moisture, contaminations and any adverse conditions during the whole receive, storage, handling, work site use cycle. When delivered from storekeeper to welders they are to be kept in suitable containers to prevent moisture or foreign substance contamination. Welding consumables which are contaminated by moisture, grease, oil or other damaging substances cannot be used.

4.2.11 Exotic material welding consumables are to be segregated from other materials at all times of receive, storage, delivery and use.

4.2.12 Storage, relocation and drying treatment procedures for welding consumables are to be submitted to Tasneef for approval.

4.2.13 Covered low-hydrogen basic electrodes supplied by recognized manufacturer in vacuum pack may be utilised for special working conditions within the limits specified or recommended by the manufacturer and provided they are suitably certified

4.3 Welding procedure qualifications

4.3.1 Welding procedure specifications including weld repair procedures, prepared in accordance with the approved welding specifications [4.1.1] and with the applicable welding standard i.e. ASME IX or other upon Tasneef approval, are to be submitted to Tasneef for approval and for witnessing of procedure qualification.

4.3.2 Prequalified welding procedures may be considered for acceptance by Tasneef provided compliance with the minimum requirements specified in this chapter is demonstrated and provided they are previously approved by an internationally recognized independent party. Complementary production tests as defined in [4.8] may be required by Tasneef.

4.3.3 The same criteria for prequalified welding procedures apply for the assessment of existing piping fabrication.

4.3.4 Welding procedure qualifications are to be performed in accordance with the approved welding specifications [4.1.1] and with the applicable welding standard i.e. ASME IX or other upon Tasneef approval. In any case the requirements specified by this chapter are to be considered as minimum requirements.

4.3.5 The qualified welding procedure specifications are generally valid for the Manufacturer owner of the qualification and for the premises where the qualification has been performed. Provided the Manufacturer has an overall quality management system covering the whole organization and in particular different workshops, yard and/or offshore working locations, the welding procedure qualification validity may be accepted for all of them by Tasneef upon verifications or validations to be specified case by case. The same clause may apply to subcontractors that are proven to be controlled by the quality management system of the main Manufacturer.

4.3.6 Validity of qualification generally lasts two years. This limit may be extended if the procedure is continuously applied and if production tests as specified in [4.8] are performed. Documented records of continuous production and of production tests are to be available for Tasneef surveyor's review.

4.3.7 The Manufacturer is to supply welding procedures specifications in accordance with ASME IX requirements including as a minimum the following details correctly identified as essential or non-essential variables:

a) type of base material (group number as defined by applicable code, type, grade, sub-grade and additional identifications related to additional properties and delivery conditions);

b) range of qualified thicknesses including qualified thickness for the different welding process in case of multi process qualification (e.g. TIG + SMAW);

c) welding consumables to be used with the welding process, code identification according to the standard, trade name and any specific properties;

d) type of joint, geometry, welding preparation and parameters (according to thickness) and associated tolerances;

e) welding positions;

f) electrical parameters (volt, ampere, travel speed, heat input) and electrodes size for each weld pass

g) any additional information like: type of shielding gas, gas flow, stick-out as applicable depending on the welding process

h) preheating, interpass and post-heating temperature and methods (as applicable);

i) post weld heat treatments, associated cycles, procedures including multi PWHTs (as applicable). The Manufacturer is to submit to Tasneef the specifications of repair procedures performed by welding with a detailed description of the procedure, including defect removal, any dimensional or position limitation for weld digging in relation to already applied stresses, preliminary inspections, thermal cycles, heat treatments and any required additional information.

4.3.8 Essential variables are to be in accordance with requirements of ASME IX. Additional essential variables are to be specified in the welding specification and the selected welding standards in consideration of specific materials and fluid service. Any condition not covered by the applicable welding standard and considered critical for the piping system testing and operations is to be also evaluated and may result in introduction of additional essential variables.

Additional essential variables to be considered, but not limited to, are listed in the following paragraphs.

- The base material:
  a) Manufacturing process (laminated, rolled, forged, hot or cold formed);
  b) Delivery conditions (e.g. normalized, thermo-mechanically rolled, quenched and tempered);

c) Temperature of final manufacturing phase or temperature of the final heat treatment;
d) Yield strength (minimum or maximum) ;
e) Carbon equivalent or pcm when hardness, toughness (Charpy or CTOD), or any combination, characteristics are specified;
f) CE or pcm, Micro-alloy content (Nb-Ti-V), S & P, Ni, and defined combination of them where sour service or services at risk of SCC risk are specified;
g) Material thickness;
h) Change in alloy composition even if within the same material group (e.g. Type 6Mo, type 22Cr-25Cr),

- Consumable:
  a) Changes in consumable brand when hardness, toughness (Charpy or CTOD), or any combination, characteristics are specified or when corrosion testing are required due service conditions.
  b) Changes in electrodes or filler wire size in root/hot passes.

- Welding direction and position;

- Electrical parameters and heat input:
  a) Increase and/or decrease as applicable when hardness, toughness (Charpy or CTOD), or any combination, characteristics are specified, when corrosion testing are required due service conditions and when sour service or services at risk of SCC risk are specified.

- Shielding gas – Type and mixture – Adding or removing – Changes in flow rate;
- Preheat temperature;
- Interpass temperature;
- Post heating;
- Post Weld Heat Treatment.

4.3.9 Additional essential variables are to be considered when hardness, toughness characteristics (either Charpy or CTOD), or any combination of them, are specified. Minimum requirements are to be defined in the welding specification and approved by Tasneef.

4.3.10 Non-destructive and mechanical tests as well as the relevant acceptance criteria to be utilised on welding procedure qualification specimens are to comply with ASME B31.3, the selected standard and the welding specification. In addition the following requirements are to apply:

a) Non-destructive tests are to be performed by personnel qualified in accordance with an international qualification scheme recognized by Tasneef;
b) Mechanical tests are to be performed in laboratories qualified by organisations recognised by Tasneef;
c) Welding procedure qualification specimens are to demonstrate absence of detectable defects;
d) Macrographic tests: weld passes are to have a regular and smooth profile, are to be of complete penetration type and are to be without injurious defects. Any additionally specified requirement for root pass of production welds is to be satisfied;
e) Additional tensile and bend tests, macro-graphic and hardness tests: when one of the above-mentioned tests does not meet the requirements, two additional tests may be permitted on specimens of the same type and from the same sample used for the previous tests. Both additional tests are to provide satisfactory results for qualification;
f) Additional impact tests: when the average value of the three tests for one position and/or when not more than one single value of the three is smaller than the requirements, three additional tests may be permitted on test specimens of the same type drawn from the same sample used for the previous tests. The average value of the six tests is to meet the requirements and not more than one value is to be lower than the minimum required value for qualification;
g) Additional testing and acceptance criteria imposed by the material or fluid service requirements (see Special Requirements).

4.3.11 Qualified ranges based of the qualification actual values of the applicable variables are to be calculated in accordance with the approved welding specifications and with the applicable welding standard i.e. ASME IX and the Rules.

4.3.12 Procedure qualification records are to be supported by clearly traceable base material test certificate and consumable test certificate.

4.4 Qualification of welders

4.4.1 Welders and welding operators are to be qualified in accordance with ASME IX and with the additional requirements prescribed by the welding specification and the selected welding standard.

4.4.2 Welders to be used for welded joints with manual metal arc process and covered electrodes, with semiautomatic gas metal arc shielded process and with gas tungsten arc welding process are to be approved by Tasneef on the base of existing and in course of validity qualification released by a recognized independent body in accordance with the welding specification or selected standard.

4.4.3 Generally, welders to be used in production are to be qualified for all welding positions qualified by the corresponding welding procedure specification. Alternatively welders may be qualified for single positions if to the in the opinion of Tasneef, they can be employed in production in a controlled manner capable to assure the respect of the qualification limits.

4.4.4 Regardless of the validity established by the selected standard Tasneef reserves the option to consider the welder qualification tests valid for two years from the date of testing and to extend the validity if welders have documented working continuity within the period not interrupted for more than 3 months.

4.4.5 Welder operations working continuity is to be recorded together with the results of non-destructive testing of the joints performed by each welder; these records are to be available for Tasneef Surveyors.

4.4.6 Welders' performance is to be monitored with regards to repair rate. A system for managing any excessive repair rate and for correcting discrepancies is to be implemented and results provided regularly to the Tasneef surveyors.

4.4.7 Welders used for tack welds that are not removed but are melted in the welding are to be qualified accordingly.

4.5 Coordination of welding and inspection activities

4.5.1 The Manufacturer is to coordinate and control welding activities and the related inspection generally in accordance with ISO 14731 and ISO 3834 which is to be considered as minimum requirements.

4.5.2 Welding coordinators and inspectors are to be suitably qualified for the covered position and the assigned responsibilities. Qualifications are to be IWE, IWT, IWS as applicable.

4.5.3 Welding specifications, welding procedure specifications and qualifications, welders qualifications and other main welding documents are to be approved by the appointed IWE.

4.6 Preheating and Interpass

4.6.1 Preheating for C-Mn steel is to be specified according to the thickness and to the Carbon equivalent C_{EQ} content and calculated as specified by the welding specification or the selected standard. The base material is to be uniformly heated at the specified temperature for a strip wide 2 times the highest thickness of the joint or at least 50 mm whichever is the lesser. Tasneef may require different values in particular cases. Preheating temperature is to be checked on the base metal outside the bevel and recorded before starting of welding activities (i.e. root pass), before re-starting of welding after any interruption and is to be accounted as minimum interpass temperature.

Preheating is to be performed in compliance with procedures approved by Tasneef.

4.6.2 The interpass temperature is to be checked on the weld bead. The temperature is set in accordance with the welding procedure specification and qualified through the welding procedure qualification. Generally the maximum interpass temperature is not to exceed 250C for C-Mn steel and 150C for austenitic stainless steel and for other exotic materials. The actually measured temperature is not to exceed the approved qualification temperature and it is to be smaller than approved preheating temperature.

4.7 Post Weld Heat treatment

4.7.1 Specifications for post weld heat treatment as well as the relevant operating procedures are to be submitted to Tasneef for review and approval.

4.7.2 Post weld heat treatment is required for welded joints on C-Mn steel of piping material and thickness as required by ASME B31.3.

4.7.3 When joints involve materials of unequal thickness the greatest thickness is to be considered in order to establish heat treatment requirements

4.7.4 Post weld heat treatment is to be considered for weld joints in sour service C-Mn piping systems regardless of thickness.

4.7.5 Post weld heat treatment temperature and duration are to be selected in accordance with criteria specified by ASME B31.3.

4.7.6 Equipment used for heat treatment is to be appropriate and is to have apparatus for recording temperature at significant points of the surfaces with tolerance within ±15°C. Each area of the surface to be heat treated (number and positioning of measuring points to be defined in the PWHT procedure) is to be recorded to allow adequate evaluation of heat treatment uniformity.

The maximum temperature difference between any point of the treated surface during the heating and cooling phases (T>300C) and during soaking time is not to exceed 30°C.

Temperature gradients in heating and cooling phases are to be appropriate for the steel type and for the size of the pieces to be heat treated.

Where possible, heat treatment is to be performed in a closed furnace. Procedures and conditions for local heat treatment are to be submitted to Tasneef for preliminary examination. Generally a region with minimum extension equal to 3 times the joint thickness on either side of the joint is to be heated to the specified soaking temperature.

4.8 Production tests

4.8.1 Production test specimens, representative of the joints welded in prefabrication and in fabrication is requested during production to check applicable mechanical and corrosion resistance properties of welded joints.

4.8.2 The number of samples is to be based on the weld joints number or on the cumulative length of the welded joints as far as it is representative of the production and of the type of the welding procedure specifications, joint types, materials, thickness and criticality of the piping systems. Production testing procedure is to be issued by Manufacturer for Tasneef approval.

4.8.3 The specimens are to be, as far as practical, welded simultaneously with the joints that they represent and they are to be positioned at the ends of the joints and welded without interruption.

The material of the samples is to be representative (e.g. same heat number or material test certificate) of the material of associated piping and it is to be controlled by the Manufacturer's material management procedure.

The above mentioned test specimens are to be mechanically tested and evaluated in compliance with the type and extension of tests required for the relevant welding procedure qualification.

4.9 Production welded joints

4.9.1 During fabrication and assembling of the piping the completed welded joints are to be 100% visually examined and inspected with non-destructive tests at the specified extension. Generally, non-destructive tests are to be performed 24 or 48 hours after welding of the joint. Shorter delayed time may be considered depending on base material type and thickness, welding parameters and geometrical constraint. When the part to be examined is to be heat treated, non-destructive tests for weld joint acceptance are to be performed after

4.9.2 The plan for non-destructive tests of piping systems is to be prepared by the Designer and the Manufacturer in accordance with ASME B31.3 and API 510 as referred in [4.12] and submitted to Tasneef for approval. Non-destructive tests method to be used and extension are to be defined in accordance with the requirements of the welding specification and of ASME B31.3 and submitted to Tasneef for approval.

4.9.3 Substitution of one specified non-destructive method with another method deemed equivalent may be proposed by Manufacturer for Tasneef approval. The substitution is to be supported by evidence of compliance with ASME V or another internationally recognized standard and Tasneef may require a validation of the proposed procedure aimed to demonstrate equivalence of the proposed alternative method with the originally specified one.

4.9.4 Suitable surveillance and inspection to detect and prevent presence of defects are to be performed by the Manufacturer during and after fabrication.

4.9.5 The Manufacturer is to notify Tasneef Surveyors of any defects detected and to make arrangements for the removal of such defects.

4.10 Repairs

4.10.1 All injurious defects found during construction and assembly of the piping are to be repaired to reinstate the compliance of the item with the specified requirements. Repairs are to be performed in accordance with approved procedures. The Manufacturer is to obtain Tasneef surveyor's approval for executing the repair and acceptance of the repaired item.

4.10.2 Repair of weld joints is to be performed with specifically qualified procedures and authorised welders.

Generally each weld repaired area is to be not shorter than 100 mm.

Parts to be post weld heat treated are to be repaired before heat treatment. Otherwise, heat treatment is to be repeated provided the utilised welding procedure is qualified for multiple heat treatments.

4.10.3 The repaired areas are to be submitted to visual examination and non-destructive tests to the satisfaction of Tasneef Surveyors. Non-destructive testing method and technique is to be the same that originally detected the defect and to be complemented with any additional testing as specified for the joint and for the piping class. The examined area is to cover the whole repair plus an extra length of 50 mm each side of the repaired area.

4.10.4 Generally a maximum of two weld repairs is to be allowed in the same area provided that the welding procedure qualification covers the original welding plus the double repair. For heat sensitive materials (e.g. duplex, superduplex) consideration is to be given to limit the repairs to a single one.

4.11 Special Requirements

4.11.1 Hardness Testing

Hardness Testing for welding procedure qualification and production testing for C-Mn steel and low alloyed steels (normal service) is to be considered an additional requirements and to be selected depending on service conditions.

General hardness minimum requirements are:

a) measured in WM, HAZ (FL+0,5mm, FL+1mm, FL+2mm) and base material;

b) measured at root and outside surface for material thicknesses up to 15mm included;

c) measured at root and outside surface and mid thickness for material thicknesses above 15mm;

d) maximum hardness is to be generally 350 HV10 but 325 HV10 might be required together with other restrictions by Tasneef for critical service conditions (e.g. specific material, fluid, high pressure, fatigue).

4.11.2 Sour Service

Welding procedure qualifications for sour service are to be in accordance with applicable NACE requirements especially with regards to hardness impression positioning, readings number and acceptance criteria.

Sour service materials and exotic materials (e.g. duplex, Ni base, type 6Mo) are to be covered by corrosion testing. Testing is to be completed in accordance with a recognized standard (e.g. NACE, ASTM). The Owner or the Designer is to produce detailed requirements and to provide them to Tasneef for review and approval.

Welding procedure qualifications for stainless austenitic-ferritic materials (e.g. duplex, superduplex) are to be covered by micro-structural examinations to be completed in accordance with a recognized standard (e.g. ASTM). The Owner or the Designer is to produce detailed requirements and to provide them to Tasneef for review and approval.

4.12 Inspection, Testing and Preservation

4.12.1 Each weld joint is to be inspected after completion and record of the completed inspection and relevant result is to be recorded.

4.12.2 Non-destructive testing methods, extension of examination and acceptance criteria are to be in accordance with ASME B31.3 as minimum requirements.

4.12.3 Inspection and testing are to comply with ASME B31.3 for process piping, with ASME VIII for pressure retaining components. Any other alternative selected standard as well as any additional requirement are to be specified by the Owner or by the Manufacturer and provided to Tasneef for review and approval.

4.12.4 Non-destructive testing is to be executed in compliance with dedicated procedures prepared as a minimum in accordance with requirements of ASME V. Procedures are to be validated via a qualification when required by ASME V and always validated for the project via practical demonstration of effectiveness and reliability. Procedures are to be provided to Tasneef for review and approval.

4.12.5 Non-destructive testing is to be executed by qualified, experienced and recognized firms implementing a quality management system certified in accordance with an internationally or nationally recognized standard.

4.12.6 Non-destructive testing operators are to be qualified according to ISO 9712 or equivalent internationally or nationally recognized standard.

4.12.7 Generally non-destructive testing operators ISO 9712 Level 2 (or equivalent) are suitable for testing execution and evaluation of results.

4.12.8 In case non-conventional or enhanced methods or techniques are used, in case of complex testing or special joint criticality (e.g. severe acceptance criteria, complex geometry, material) and at discretion of the Tasneef surveyor the operator may be required to have its qualification validated for the specific procedure. Validation may be obtained via a theoretical and/or practical demonstration including equipment calibration, testing execution, detection-evaluation of flaws and final reporting.

4.12.9 Non-destructive testing activities are to be managed by a ISO 9712 Level 3 (or equivalent) who is to be responsible to approve non-destructive testing procedure, operators qualifications, examination results and in general to be responsible for the overall quality of the non-destructive testing activities and their compliance with the applicable specifications and standards.

4.12.10 Extent of non-destructive testing is to be as a minimum in accordance with ASME B31.3 depending of the fluid service category.

4.12.11 Whenever the non-destructive testing extent is assigned in percentage less than 100% the progressive examination is to be applied in accordance with ASME B31.3 and the percentage is to be applied with reference to representative samples. Criteria for selecting the sample is to ensure due coverage of welding procedure specification, welders, welding locations and production periods.

4.12.12 The extent of visual inspection on piping weld joints is to be 100% of the weld length for each pressure retaining weld joint including fillet welds like socket or lap joints. Fillet welds of piping supports and other attachments like doubling plates and saddles are also to be 100% visually inspected.

4.12.13 The Owner or the Manufacturer is to consider any project specific fluid service and criticality and consequently specify additional requirements with regards to extension of non-destructive testing and/or specific or more severe acceptance criteria.

4.12.14 Extent of non-destructive testing is to be as a minimum in accordance with ASME B31.3 depending of the fluid service category. Additional requirements are to be considered by the Owner or Manufacturer on the base of critical fluid service or operating conditions.

4.12.15 The following non-destructive testing methods are generally suitable to cover standard weld joint examination:

- Visual and dimensional inspection of weld surface and profile;
- Magnetic and Penetrant testing for surface testing;
- Radiographic and Ultrasonic testing for volumetric testing.

The methods are usable and to be executed in accordance with prescriptions and limitations specified by ASME V for each method.
Additional requirements and limitations are specified in the following chapters.

4.12.16 Radiographic testing thickness and material limitations indicated by ASME V are to be considered as minimum requirements. Manufacturer is to demonstrate that for each radiographic technique the required values of density and sensitivity are consistently achieved and that the technique is effective in detecting all the type of flaws expected for the weld process.

4.12.17 Fin grain, very fine and extra fine grain are to be selected on the base of the fluid service and piping line criticality as well as on the base of material type and thickness..

4.12.18 Ultrasonic testing can be used in lieu of radiographic testing when admitted by ASME V and by ASME B31.3 and applicable code cases.

4.12.19 Any use exceeding the limits specified by the mentioned codes, any use on clad or austenitic material or any use of advanced techniques (TOFD, Phased Array) is to be proposed by the Manufacturer to the Owner and to Tasneef review and approval. The proposal is to be supported by a qualification and validation program capable to demonstrate the effectiveness of the method and related technique by comparison with radiographic testing. The proposed procedure is to prove better sensitivity and probability of detection with regards to radiographic testing. Non-destructive testing operators' qualifications are to be validated on the specific technique.

4.12.20 Acceptance criteria for radiographic and ultrasonic testing are to be in accordance with ASME B31.3 and to be selected depending on the piping fluid service.

The Owner or the Manufacturer is to specify more severe criteria depending on critical fluid service or materials.
Acceptance criteria for magnetic and penetrant testing are to be in accordance with ASME Section VIII.
Any deviation, including upgrading, of acceptance criteria is to be provided to Tasneef for review and approval.

4.12.21 Visual inspection of exotic materials weld joint and heat affected zones both external and internal, as far as practical, is to include verification of any unacceptable oxidation resulting in material discoloration. Reference for acceptance criteria may be found in NORSOK M-601-Annex B. This requirement is to be consistent with any required chemical cleaning or passivation process.

4.12.22 Piping system potentially at risk of stress corrosion cracking or hydrogen induced cracking phenomena caused by either chlorides or hydrogen sulfide (sour service) or any combination of them are to be covered by non-destructive dedicated and more severe extension and acceptance criteria. These additional requirements are to be provided to Tasneef for review and approval.

5 Pressure Testing

5.1 General Requirements

5.1.1 The Designer or the Manufacturer is to prepare a pressure testing specification indicating the minimum requirements:

- safety
- test pressure and acceptance criteria
- pressure test fluid characteristics
- testing variables values (e.g. ambient, metal, media temperature – test duration)
- pressure and temperature measuring and recording requirements
- flushing, flashing, drying, reinstatement and preservation (as applicable)
- test records.

5.1.2 Piping materials (pipe and fittings) and piping components are to be individually pressure tested in accordance with the product standard requirements by the manufacturer and record of testing is to be available with the material test certificate. The same applies to prefabricated piping spools.

5.1.3 Each piping system or sub-system as applicable is to be pressure tested in accordance with requirements of ASME B31.3.

5.1.4 Hydrostatic testing is to be the first option for pressure testing.

5.1.5 Pneumatic test may be considered in lieu of hydrostatic test provided suitable engineering justifications are submitted to Tasneef for approval and provided compliance with ASME B31.3 is demonstrated.

5.1.6 The Owner or the Manufacturer is to define the philosophy and the general requirements for leak testing to ensure tightness of mechanically completed and already hydro-tested piping systems.

5.1.7 Tightness may need to be confirmed also upon reinstatement of piping systems after partial disassembly occurred during commissioning or maintenance.

5.1.8 Leak testing is to be executed using nitrogen complemented with a specified % of tracing gas (e.g. helium).

5.1.9 The leak testing specification is to define as a minimum the criteria for selecting piping systems to be leak tested, the leak test pressure, the test media and the acceptance criteria depending on the piping service conditions. The leak testing specification is to be provided to Tasneef for review and approval.

5.1.10 Pressure test results are to be recorded in approved charts and forms containing all the recorded essential variables and results and being approved by representatives of the responsible parties. Pressure test reports are to be retained within the mechanical completion documentation.

6 Chemical cleaning and passivation

6.1 General requirements

6.1.1 The Owner or the Manufacturer are to prepare a specification containing all the requirements for chemical cleaning and/or passivation for carbon steel, austenitic stainless steel, nickel base materials and any other alloy piping and tubing. The specification is to be provided to Tasneef for review and approval.

6.1.2 Minimum requirements are that appropriate internal and/or external surface chemical cleaning is to be performed on piping and tubing lines where:

- the service performance can be affected by any type of contamination in the fluid (e.g. lubricant and seal oils, hydraulic oil, suction lines of compressors, instrument air tubing);
- the piping materials has been exposed at risk of contamination during fabrication, installation and testing activities and the contamination may damage original material characteristics or affect the expected corrosion resistance and in turn reduce the service life (e.g. corrosion resistant alloy contaminated by ferritic material or by chlorides, copper alloy).

6.1.3 Stainless steel materials affected by oxidation and discoloration due to thermal processes (e.g. welding) are to be passivated in the heat affected area with suitable pickling methods to be selected depending on the base material, the oxidation level and the required corrosion resistance.

6.1.4 The owner and the Manufacturer are to prepare a specification containing the requirements for final reinstatement and preservation of the piping systems. The specification is to be provided to Tasneef for review and approval.

7 Mechanical Completion Documentation

7.1 General requirements

7.1.1 The mechanical completion of the piping systems is to be documented by using test packs prepared and controlled in accordance to an approved procedure.

7.1.2 Test pack is to contain as a minimum:

- as built construction drawings

- material test certificates and material traceability
- welding records including procedure qualifications, welder qualifications, weld joints traceability
- non-destructive testing records
- inspection test reports (as applicable)
- pressure test records
- flushing, flashing, drying, chemical cleaning, reinstatement records (as applicable)
- leak test records

PART D CHAPTER 5

QUALITY ASSURANCE AND QUALITY CONTROL

1 General Requirements

1.1.1 Quality assurance and quality control principles and procedures as indicated and described in ISO 19902:2007, Clause 21 are to cover the overall fabrication, inspection, testing, transportation and installation of the fixed offshore platforms including structure and topsides.

1.1.2 Quality assurance and quality control are to be adequate to ensure compliance of the mechanically completed structure and topside with the design and applicable standards requirements in order to provide the specified final quality level.
Minimum requirements of a quality system are indicated in ISO 19902, Table 21.2.1, which is also specifying different quality system level depending on exposure level.

1.1.3 Particular care is to be paid to the quality control scheme and related inspection procedures and frequencies that are to be effective in order to prevent non-conformances or correct any of them so to assure adequacy of the delivered platform.

1.1.4 Quality assurance and quality control system and related procedures are to be issued to Tasneef for information, review or approval as applicable.

2 Quality Management System

2.1.1 The overall project execution as well as each single phase is to be covered by a Quality Management System designed and implemented in accordance with ISO 19902, Clause 21.2 and the therein referred ISO 9000 series (ISO-9001 through ISO-9004).

3 Documentation

3.1.1 Fabrication, inspection, testing, transportation and installation of the fixed offshore platforms including structure and topsides are to be documented in accordance with ISO 19902, Clause 21.7 including documentation requirements complying with ISO 19902, Table 21.7-1.

PART D CHAPTER 6

PROTECTION AGAINST CORROSION

1 General

1.1 General requirements

1.1.1 The structural components and process items of the platform are to be protected against corrosion in relation to adopted materials, service conditions and expected operating life.

1.1.2 In general, the corrosion protection system is to be adopted at design stage with the aim of avoiding a potential reduction of the strength of structural components and of loss of containments of pressure vessels.

1.1.3 The corrosion protection systems adopted, their design, relevant materials, manufacturing and installation procedures are to be subject to Tasneef approval according to the classification or certification purpose.

1.1.4 Special consideration is to be given to the protection both of steel members that are difficult to inspect or repair after installation and of those members which are located in particularly aggressive environments, such as the splash zone for structural components or specific service conditions for process components.

The splash zone is that portion of the platform between the following heights measured from the sea bottom:

- sea depth plus the maximum tide and 65% of the wave height having recurrence frequency equal to 0,01;
- sea depth minus the minimum tide and 35% of the above wave height.

1.2 Reference standards for the corrosion protection

1.2.1 The following standards are reported as main reference standards that can be used by the Designer or by the Owner for the corrosion protection design and corrosion control of the different platform components:

- Structure
  - o ISO 19902 Fixed Steel Offshore Structures, Clause 18
  - o NACE Standard RP0169
- Drilling equipment:
  - o API 5D Specification for Drill pipe
  - o API RP 7G RP for drill stem design and operating limits
  - o API 8 A-C Specification for drilling and production hoisting equipment
- Oil-country tubular goods:
  - o ISO 11960 Petroleum and natural gas industries- Steel pipe for use as casing and tubing for well
- Line pipe and piping system:
  - o API 5L spec. for pipe line
  - o API 2RD Design of riser for floating production system and tension- leg platform
  - o API 5LC CRA Line pipe
  - o API RP 14E RP for design and installation of offshore production platform piping system
  - o API 581 Risk Based Inspection
  - o ISO 3183-3 Steel pipe for pipeline – Technical delivery condition – pipe of requirement class C
- Completion and subsea equipment:
  - o API RP 17A RP for design and operation subsea production system
  - o API 14A specification for subsurface safety valve equipment
  - o NACE 1D199 Internal corrosion monitoring of subsea production and injection system
- Fluid handling machinery:
  - o API 610 etc. Specification for positive displacement machinery

1.2.2 For cathodic protection design covering different applicable issues, reference can be made to the NACE Recommended Practice (RP) number 0575, 0186, 0169, 0193, 0200, 0176, 0387, 0492, 0388 and 0196.

1.2.3 For standard test method related to cathodic protection reference can be made to NACE TM 0497, 0102, 010 and 0190 as applicable.

1.2.4 For material in sour service, reference can be made to NACE MR0175/ISO Material for use in H2S-Containing environments in oil and gas production

1.2.5 Standards and methods different than those above mentioned can be used for design and protection of the various parts of the platform possibly subject to corrosion provided that they are shown effective and equivalent to reach the required targets of safety and durability addressed in these Rules.

2 Corrosion environment

2.1 Corrosion zones

2.1.1 Marine corrosion environments for the various platform's items can be divided into the following corrosion zones, with relevant indication of main environmental parameters affecting corrosivity:

- Seawater for submerged and buried items:
    - High salt concentration, mainly sodium chloride
    - Temperature
    - Time of wetness
    - High electrical conductivity
    - Relatively high and constant pH
    - Solubility for gases, of which oxygen and carbon dioxide in particular are of importance in the context of corrosion
    - The presence of a myriad of organic compounds
    - The existence of biological life, to be further distinguished as microfouling (e.g., bacteria, slime) and macrofouling (e.g., seaweed, mussels, barnacles, and many kinds of animals or fish).
- MIC (microbiological influenced corrosion):
    - The microorganisms, directly or by metabolism products, starts, or increase, the corrosion process both in aerobic and anaerobic environment.
- CUI (corrosion under insulation):
    - For process piping with operating temperature below 120°C
- Internal corrosion (for process items):
    - Low temperature (aqueous) corrosion occurring below approximately 500 °F (260°C) in the presence of water.
    - High temperature (non-aqueous) corrosion occurring above approximately 400 °F (205°C) in the presence of liquid or gaseous hydrocarbons,.

2.2 Corrosion rate

2.2.1 According to the different corrosion zones, relevant corrosion rate, in relation to construction materials, fluids and operating conditions is to be established in relation to applicable standard, such as API 581 or equivalent.

3 Corrosion control and protection systems

3.1 General

3.1.1 The following systems may be used for corrosion control of the steel structures and of the process items:

- coatings, linings and wrappings;
- cathodic protection;
- corrosion-resistant materials (including cladding);
- corrosion allowance;
- corrosion inhibitor.

3.2 Selection Criteria

3.2.1 The selection and design of the specific corrosion protection system is to be based, at least, on the following general aspects:

- contingent local laws;
- type and severity of foreseen corrosion in terms of both process conditions (for internal corrosion) and environmental conditions (for external corrosion);
- design service life (including possible lifetime extension, if required);
- accessibility for inspection and maintenance;
- suitability, reliability and availability of different techniques for corrosion control,

and the following parameters, depending on the location and function of the different components of the platform:

- parameters characterizing the sea water and sea bottom environment:
    - temperature;
    - oxygen content;
    - chemical composition;
    - resistivity;
    - pH value;
    - sea current velocity;
    - erosion due to suspended solids;
    - biological activity.
- parameters affecting the environment of the internal surfaces:
    - humidity;
    - condensation;
    - temperature;
    - properties of electrolytes;
    - corrosivity of substances which may be present.

- relevant parameters for surfaces to be protected:
  - o shape;
  - o location;
  - o effects of damage due to corrosion;
  - o possibility of inspection and repair.
- Relevant parameters for process items to be protected:
  - o operating conditions (temperature, pressure, partial pressure or fugacity when necessary);
  - o heat and material balance (with relevant pollutant elements);
  - o construction material (with relevant cladding or lining if any);
  - o painting and insulation;
  - o effects of damage due to corrosion;
  - o possibility of inspection and repair.

3.3 Corrosion protection for structures

3.3.1 For corrosion control and protection systems design requirements for structures, general reference is to be made to ISO 19902:2007, Clause 18.

3.3.2 Special corrosion protection systems are to be provided for structural steel members in the splash zone in addition to the increase in thickness required in Part B Chapter 4, [3.2.5].

3.3.3 Structures above the splash zone are normally to be protected by painting.

3.3.4 Metallic surfaces below the splash zone, including surfaces of embedded members (piles, skirts, etc.), are to be protected by a cathodic protection system or by impressed current.

3.3.5 Possible internal surfaces of structures exposed to sea water are to be protected, as far as applicable, both by a cathodic system and by coating.
In any case, the use of impressed current is to be avoided in spaces where the water change is inhibited or considerably restricted.

3.3.6 Protective systems other than those above may be accepted at the discretion of Tasneef.

3.4 Corrosion protection for process items

3.4.1 For the different process items, the possible type of damage is to be identified by taking into account the different operating conditions, then appropriate techniques that can be used to minimize each type of general or localized corrosion is to be implemented for the various items (e.g. vessels, heat exchangers, pumps, compressor/GT generators, package units) possibly affected by occurring corrosion.

3.4.2 The different techniques and materials used to reduce, or prevent, the corrosion may be also defined using a mathematical model for the corrosion prediction.

3.4.3 The prediction of internal and external corrosion is to be the basis for the definition of an appropriate inspection plan that is to be considered integral part of the safety management and maintenance programme for the different items all along the service life.

3.4.4 In general an inspection plan is to be provided for in order to map the possible corrosion of the process items, according e.g. a RBI philosophy as outlined in Part x Chapter y. Specific inspection scheduling is therefore dependent on the adopted corrosion prediction methodology and control philosophy, however a first inspection should be carried out not later than two years after that the single process system has been put into operation.

4 Protection by coating systems

4.1 Definitions

4.1.1 Coating is made by thin (<1mm) single or multiple organic or metallic layers, applied by spraying, brushing or dipping;

4.1.2 Cladding, lining and wrapping are corrosion protective layers (≥1mm) applied in order to avoid wave action erosion (for the submerged structure or piping) or fouling and external corrosion.

4.2 Protection by coating

4.2.1 The design of all components to be paint coated shall take into account relevant measures to ease both the initial application and following maintenance.

4.2.2 Approval of protective coating systems will be granted on the basis of information relating to:

- type and trademark of coating;
- adhesion and resistance to sea water;
- service temperature;
- resistance to ageing;
- resistance to mechanical damage;
- resistance to deterioration caused by cathodic overprotection;
- compatibility of different types of coatings applied;

- possibility of repairs during construction, installation and service;
- procedure and directions for the application.

4.2.3 The preparation of surfaces and the application of coating are to be performed when the surface temperature exceeds the dew point by at least 3°C or when the relative humidity of the air is below 85% or as recommended in the Manufacturer's specifications. In order to have a guide for coating, for the following points:

- Effective electrical insulator.
- Effective moisture barrier,
- Applicability,
- Ability to resist development of holidays with time,
- Good adhesion to pipe surface,
- Ability to withstand normal handling, storage (UV degradation), installation,
- Ability to maintain substantially constant electrical resistivity with time,

4.3 Protection by cladding or lining

4.3.1 Approval of protective cladding or lining systems will be guaranteed on the basis of information relating to:

- type and trademark of coating or lining;
- resistance to pollutant elements;
- service temperature, pressure, partial pressure or fugacity;
- resistance to mechanical damage;
- possibility of repairs during construction, installation and service;
- procedure and directions for the application.

5 Cathodic protection

5.1 General

5.1.1 Cathodic protection is applicable to the submerged and the buried zones. Cathodic protection may be realized by:

- galvanic (sacrificial) anodes,
- impressed current (IC) from one or more rectifiers.

5.2 Protection by sacrificial anodes

5.2.1 Approval of sacrificial anode protection systems is based on examination of information relating to:

- area of surfaces to be protected;
- electrical connections;
- density of protective current;
- total number, distribution and characteristics of anodes;
- method of calculation used for the determination of the number and size of anodes to be fitted;
- anode installation;
- monitoring system.

5.2.2 The cathodic protection system is to supply a current sufficient to maintain the potential values given in Tab 1 at all points of surfaces to be protected.

5.2.3 The design current density is to be based on the environmental service conditions of the platform.

5.2.4 The presence of stray currents (induced by welding processes by connection between structural members of different material etc.) and their possible influence on the cathodic protection system are to be carefully considered.

5.2.5 Metallic structures which do not belong to the structure of the platform but are electrically connected to it are to be considered in the design of the cathodic protection system.

5.2.6 The required potential is to be maintained for the whole design life of the platform.

5.2.7 The potential difference with close circuit ˜V and the electrochemical efficiency of sacrificial anodes are to be documented by appropriate tests.

5.2.8 Each anode is to be capable of delivering the total protective current (protective current density per total surface to be protected).

The method of calculation of the current delivered by each anode is to be submitted to Tasneef for approval.

The anodes are to be located so as to give a uniform current distribution over the whole steel structure.

5.2.9 The lifetime T of an anode, in years, is to be determined by the following formula:

$$T = \frac{Mr}{I} f\ C$$

where:

M: net mass of the anode, in kg;

r: anode efficiency;

I: mean current output during the lifetime T, in A;

f: utilisation factor, to be taken equal to 0,8;

C: theoretical current output of the anode, defined as the mean current output in one year per unit mass of the anode, in (A · year)/kg

For guidance, the following maximum values of anode efficiency r are given:

- for slender anodes: 0,9
- for other shapes of anodes: 0,8.

5.2.10 The anode core and supports are to be designed so as to ensure the anode integrity during all phases of the design life of the platform.

5.2.11 A permanent monitoring system is to be installed for measuring the potential at locations where inspection is impracticable.

5.2.12 An effective electrical connection is to be provided between anodes and the structure to be protected; welded connections are recommended for this purpose.

In positioning the anodes, due regard is to be given to structural points while direct connections to areas subject to high stress level are to be avoided.

Welding between anodes and structural members is to be carried out according to procedures which comply with those adopted for the fabrication of the structural members themselves.

Table 1 : Potential, in volts, for cathodic protection

Type of steel	Reference electrode		
	$Cu/Cu\ SO_4$	Ag/Ag Cl	Zn
Steel in aerobic environment: a) upper limit b) lower limit	- 0,85 - 1,10	- 0,80 - 1,05	+ 0,35 0,00
Steel in anaerobic environment: a) upper limit b) lower limit	- 0,95 - 1,10	- 0,90 - 1,05	+ 0,15 0,00
Higher strength steel (ultimate tensile strength >800 N/mm^3) a) upper limit b) lower limit	- 0,85 - 1,00	- 0,80 - 0,95	+ 0,35 + 0,10

5.2.13 The anode surface is to be 100% visually inspected to check that it is free from deposits or defects which might affect the anode efficiency. Attachment welds of anodes are to be inspected and tested in compliance with the requirements of Part D Chapter 3 [5.11] by considering such welds as for secondary structures, with particular attention to be paid to ensure continuous sealing and integrity to guarantee the anode presence and function in service following to the fabrication and installation phases.

5.3 Protection by impressed current

5.3.1 The corrosion protection system by impressed current is to comply with the requirements of items from [5.2.2] to [5.2.5].

5.3.2 The approval of such protection systems is based on information relating to:

- area of surfaces to be protected;
- electrical connections;
- current density;
- general arrangement;
- anodes, anode shielding, rectifiers, cables, cable connections and electrical circuits;
- monitoring system.

5.3.3 The anodes of the system are to be located and shielded so as to give a uniform current distribution of all surfaces to be protected.

5.3.4 The platform is to be provided with suitable instrumentation for measuring of the potential.

5.3.5 The electric current generator is to be tested to check that electrical connections are adequate and no damage has occurred during the installation.

Cables and electrical connections are to be carefully inspected to detect possible insulation defects, which are, in any event, to be properly repaired.

Anodes are to be inspected to check that their shape and material are in accordance with design specifications.

6 Corrosion allowance

6.1 General

6.1.1 A corrosion allowance (i.e. steel thickness increase to compensate for the effect of metal loss by corrosion on structural integrity or for piping or process) can be used alone or in combination with a coating to maintain the structural component or the pressure equipment with the required safety margin against expected corrosion rate. The extra thickness accounting for any corrosion allowance at design stage is to be determined taking expected corrosivity, design service life and maintenance measures into consideration.

7 Installation and testing of effectiveness of the systems

7.1 General requirements

7.1.1 After each cathodic protection system has been put into operation, testing is to be carried out to ensure that the steel structure potential is within the required range.

This testing is to be carried out within:

* one year for sacrificial anode systems;
* one month for impressed current systems.

7.1.2 The test equipment and procedure, as well as the number of measurements of the potential to be carried out, are to be approved by Tasneef.

7.1.3 The reference electrode is to be positioned as close as possible to the surface point selected for the measurement.

8 In-service inspection, maintenance and monitoring of corrosion control system

8.1.1 In-service inspections, maintenance and monitoring of the corrosion control system designed and installed for the structures of the platform are to be carried out in compliance with ISO 19902:2007, Clause 18.6.

8.1.2 Corrosion monitoring is used to detect, predict and prevent corrosion failure with its consequent safety, environmental and economical implication. The general philosophy of corrosion monitoring is that multiple techniques can be used to both complement and check each other. The corrosion monitoring can be performed by four different ways:

- Process variables monitoring;
- Corrosion probe monitoring;
- Not destructive testing (NDT);
- Simulation program monitoring.

8.1.3 Internal corrosion monitoring is recommended to be put in place in the topside facilities.

8.1.4 Planning of schemes for inspection and monitoring of corrosion control for the process items are to be in compliance with the applicable standards mentioned in [1.2.1]; the recommended techniques and methods for internal corrosion monitoring are the following ones:

- Weight-loss coupons;
- Electrical Resistance Probe;
- Electrical Field Mapping Sensor;
- Ultrasonic sensor technologies;
- Erosion and sand detection method;
- Electromagnetic acoustic transducer technology (EMAT).

8.1.5 Inspection of coatings and linings is primarily performed by visual inspection and has as its main objective the assessment of the need for maintenance (i.e. repairs).

8.1.6 The inspection of cathodic protection system for structures is to be in compliance with ISO 19902:2007, Clause 18.6.3: different rules are to be approved by Tasneef.

8.1.7 The corrosion control maintenance plan is to be updated after each inspection, according to the monitoring system outcomes.

RULES FOR THE CLASSIFICATION OF STEEL FIXED OFFSHORE PLATFORMS

Part E

Chapters **1**

PART E CHAPTER 1

MARINE OPERATIONS

1 General requirements

1.1 Application

1.1.1 The requirements of this Chapter apply to all marine operations necessary for the load out, transportation and installation of fixed offshore platforms, limited to those aspects of such operations which may influence the safety of the whole platform or of some of its components.

1.1.2 These operations are specific subject of either the classification of the platform or the certification of marine operations service (see Part A, Chapter 2, [3.2.1]) and are to be supervised by Tasneef accordingly.

1.1.3 As "Marine Operation" it is meant whatever activity performed in marine environment in order to transport, install or remove a structure, including the engineering design and planning of the activity itself. Typical examples of marine operations for fixed platforms are:

- load out onto cargo barges or other floating units;
- transportation from the construction yard to the installation site;
- lifting from the transport barge and lowering to final position or to a free-floating condition;
- launch and upending;
- positioning and ballasting;
- penetration in the sea bed and levelling;
- pile driving and grouting;
- construction in floating condition or in open sea;
- subsea operations and seabed intervention.

1.1.4 As the requirements of this Chapter cover various types of platforms and several types of operations, it is understood that the various provisions are to be applied when appropriate in relation to the type of platform and operation concerned.

1.1.5 Special operations with uncommon features, procedures and solutions, other than those specified in this Chapter, will be specially considered on a case-by-case basis.

1.2 Reference standard

1.2.1 In addition to the provisions of this Chapter, and as general reference, the marine operations relevant to a fixed offshore platform are to be planned and executed according to ISO 19901-6:2009, as far as applicable, in addition to the provisions of this Chapter.

1.3 Documentation

1.3.1 Marine operations are to be carried out in accordance with approved procedures and under Tasneef supervision (see [1.1.2]).

1.3.2 The procedures and the main supporting documents for the operation design and planning are to be included in the "Marine Operation Manual" and should be prepared and submitted for Tasneef approval sufficiently in advance prior to the start of the operations.

1.3.3 For general requirements relating to documentation see Clause 6.5 of ISO 19901-6:2009.

1.4 Environmental actions

1.4.1 Characteristic parameters relating to the design environmental conditions for the start and the execution of each operation must be specified in the "Marine Operations Manual" (see [1.3.2]) and submitted for Tasneef review.

1.4.2 Loads and their effects during marine operations are to be determined in accordance with the applicable requirements of Section B of these Rules and Clause 7 of ISO 19901-6:2009.

1.5 Weight control

1.5.1 Marine operations are particularly sensitive to the weight of the items to be moved and installed. A careful activity of weight control is to be put in place, according to and Clause 8 of ISO 19901-6:2009.

1.6 Hydrostatic stability

1.6.1 The requirements of this paragraph apply to a floating system which may consist of:

a) the platform;

b) the parts of the platform;

c) the platform or parts thereof and the support units.

Stability requirements for floating objects are to be determined in accordance with the requirements of Clause 9 of ISO 19901-6:2009.

1.6.2 The floating system is to have sufficient stability and reserve buoyancy during all stages of marine operations.

1.6.3 The following requirements are to be complied with:

a) the actual metacentric height of the system is to be at least 1 m;
b) the heel of the floating system due to the extreme wind which is compatible with the carrying out of operations, towing and mooring loads is not to exceed 5 degrees;
c) the floating system is to be capable of withstanding accidental rapid increases in loading during transfer of heavy loads.

1.6.4 The requirements of the above items a), b) and c) may be waived in special cases provided that adequate measures are taken which ensure the same degree of safety.

1.6.5 Before starting any operation during which stability may be critical, a stability test may be required in accordance with procedures previously agreed with Tasneef.

1.7 Mooring systems

1.7.1 The mooring system, used to maintain the platform or the transportation and installation vessels in the required position during the marine operations, is to be designed to withstand all the relevant design loads (see [1.4]).

1.7.2 In the design of the mooring system, the requirements given in Part B Chapter 1, [3.1.3] and [3.1.5] are to be taken into account.

1.8 Electrical and mechanical systems

1.8.1 The platform is to be equipped with all systems necessary to keep it under complete control during marine operations.

1.8.2 Depending on the nature and complexity of the operations, a separate study may be required for the purpose of selecting the most suitable system to ensure safe operation.

1.8.3 Systems are to be designed, constructed and installed in compliance with the applicable requirements of Tasneef Rules and other recognised standards.

1.9 Instrumentation

1.9.1 To keep the platform under effective control during construction, adequate instrumentation may be required to monitor:

a) loads and deformations;
b) environmental conditions;
c) ballast and stability conditions;
d) heel, trim and draft.

1.9.2 All essential instruments are to be duplicated.

1.9.3 For relevant general requirements, see the previous par. 1.8.

1.9.4 All instruments used are to be tested and calibrated prior to the start of operation, to the satisfaction of Tasneef.

1.10 Equipment for special operations

1.10.1 Systems and equipment used for special operations such as deck mating, installation of modules, etc. are to be thoroughly specified so as to permit the proper carrying out of operations and the evaluation of loads imposed on the structures.

1.10.2 The following documentation is to be submitted to Tasneef:

a) description of the equipment;
b) general arrangement and layout plans;
c) strength calculations;
d) material specifications;
e) construction and installation specifications.

2 Load out

2.1 General requirements

2.1.1 This item covers the operations necessary to move a structure from one supporting condition to another. Such operations may be performed by means of:

a) SPMT trailers;

b) Lifting;

c) Pushing/pulling;

d) Ballasting variations (float off).

2.1.2 The levelling and tolerances on supports, skidways, etc. are to be such that overstresses on the structure due to ineffective restraint conditions are avoided during all stages of the operation.

2.1.3 Load out operations shall be planned and executed according to Clause 11 of ISO 19901-6:2009.

3 Transportation

3.1 General requirements

3.1.1 This item covers the operations necessary for transportation of the platform or parts thereof from the construction or assembly yard to the final location.

3.1.2 Transport operations shall be planned and executed according to Clause 12 of ISO 19901-6:2009.

3.2 Towing operations

3.2.1 Motion responses of the towed unit are to be analysed in relation to the environmental conditions and loads specified under par. 1.4.

3.2.2 Towing arrangements and pulling force (tug bollard pull) are to be such that the steering of the towed unit is ensured under adverse sea, wind and current conditions and in restricted waters.

3.2.3 Towing arrangements are to be so designed that failure of the towed unit will not occur due to possible overload.

3.2.4 The effects of towing force, wind, ballasting operations, etc. on the trim/heel of the platform are to be taken into consideration.

3.2.5 Provisions are to be made for reliable weather forecasting prior to and during the transportation.

4 Installation

4.1 General

4.1.1 The operations necessary for the installation of the platform may consist of positioning, setting, pile driving, etc.

4.1.2 Installation operations shall be planned and executed according to Clauses 17 and 18 of ISO 19901-6:2009.

4.1.3 Where the installation operations may cause the overloading of structural components, the effects of such overloading are to be monitored and controlled.

4.1.4 As regards the general requirements for the installation instrumentation, the provisions in [1.8] and [1.9] apply. The instrumentation used for the control of the platform during the installation may include devices suitable for measurement of draft, penetration/settlement, inclination, ballast levels and parameters relating to environmental conditions.

4.2 Lifting

4.2.1 It is to be verified that the structures to be lifted and the relevant lifting points have sufficient structural strength for the operation. Special attention is to be paid to the evaluation of the dynamic effects of loads.

4.2.2 The weight control process, including physical weighing, shall be demonstrated to have been properly managed, so that the weight and centre of gravity data are reliable enough to avoid unexpected overload or tilt during the operation. See also previous par. 1.5.

4.2.3 For all lifting operations, the effectiveness and the structural strength of the equipment used are to be considered. Such equipment may consist in:

a) Vessel or barge mounted cranes;

b) Rigging system (slings, shackles, spreader frames, etc.).

c) Mooring system.

4.2.4 Stabbing guides installed to ensure a smooth gradual placing of lifted parts are to have adequate strength and be so built that accidental overloads do not lead to damage to primary structures of the platform.

4.3 Launching and upending

4.3.1 Where a platform jacket is to be launched from a barge, the barge is to be provided with suitable arrangements for launching operations. Launch ways and rocker-arm arrangements are to be checked with regard to their suitability and structural strength.

4.3.2 The launching design is to be such that the stresses imposed on the platform will not exceed the allowable limits at any time.

4.3.3 The platform jacket prepared for launching is to be provided with sufficient reserve buoyancy to compensate possible inaccuracies in the calculation of weights and buoyancy.

4.3.4 It is to be verified that the jacket will behave in a stable manner during and after launching and upending phases, and that sufficient bottom clearance is ensured to prevent impacts and grounding.

4.3.5 Buoyancy tanks, supports and other arrangements are to have adequate structural strength to withstand forces imposed during launching and upending operations. In particular, the buoyancy tanks, which are subject to hydrostatic pressure, are to be carefully inspected to detect possible imperfections which might reduce their structural strength.

4.4 Positioning and flooding

4.4.1 The jacket is to be positioned within the arranged area. Where the sea bed has been specially prepared, the tolerance in positioning is to be determined on the basis of the extent and nature of the preparation.

4.4.2 The flooding of the jacket is to be carried out under continuous control. The influence of possible inaccuracies in the evaluation of water depth, the topography of the sea bed and obstructions thereon is to be carefully considered.

4.4.3 Sudden or large motions during touchdown of the jacket are to be avoided.

4.5 Penetration and levelling

4.5.1 The ballast system is to permit the safe lowering and penetration of the jacket into the seabed or onto the preinstalled piles. The ballasting process is to be reversible during critical stages of the above operations.

4.5.2 The ballasting capacity of the system is to ensure that the required penetration will be reached even in the presence of soils having penetration resistance higher than expected. The ballast system is also to be capable of achieving asymmetric ballasting in order to maintain the inclination of the jacket within the predetermined limits even in the presence of soil compactness variations in the area of the foundations.

4.5.3 The final levelling must be incompliance with the project specification. The pile driving sequence should be defined after lowering, in order to adjust possible out of verticality. Levelling tools, such as hydraulic jack assemblies, should be designed and available on board for further verticality correction.

4.6 Pile installation

4.6.1 Pile installation operations are to be planned and performed so as to avoid the reduction of the mechanical properties of the various soil layers crossed.

4.6.2 The sequence of installation operations is to ensure sufficient stability of the jacket during the whole duration of the installation.

4.6.3 Suitable instruments are to be provided for recording of energy input to the pile and of corresponding pile penetration.

4.6.4 Jetting is usually allowed only inside a pre-installed pile casing to a depth which cannot influence the soil at the pile end.

4.6.5 Below such pile end, only controlled drilling with carefully selected drilling fluids is permitted.

4.6.6 During drilling and grouting, the fluid pressures in the hole are to be compatible with the fracture limit of soil formations crossed and with the hole stability.

4.6.7 If the connection between pile and structure is welded, such welding must be sized, executed and tested according to the design and fabrication criteria described in these Rules.

4.6.8 The installation of conductor pipes should follow the same prescriptions as for piles.

4.7 Grouting

4.7.1 The placement of grout for filling of voids between piles and sleeves or boreholes is to be carefully planned. Such grout is to have density and setting time which are compatible with the proper carrying out of the pumping operation.

4.7.2 The grouting is to be carried out with due attention paid to keeping the stresses well within the allowable limits in respect of the integrity of structure and foundation.

4.7.3 The system used is to be capable of removing the trapped water and of transferring a sufficient amount of grout to the desired locations.

4.7.4 For general requirements on grout, see Part B Chapter 5 [2.9].and Part D Chapter 3 [4.1.1] for cement.

4.8 Installation of structural parts

4.8.1 The geometrical tolerances on structural parts to be installed (well head modules, bumpers, boat landing, topside modules, living quarter, helideck, flare, etc.) are to be carefully determined prior to the commencement of each operation.

4.8.2 After the installation of each structural part, it is to be verified that the actual restraint condition complies with the design condition. The coupling should always be completed by welding.

4.9 Special operations

4.9.1 Special operations are those necessary for the installation of special platform components such as scour protection systems, draining systems, risers, etc.

4.9.2 Such operations will be specially considered in each case in relation to their influence on the integrity of structures and foundations.

5 Decommissioning and removal

5.1 General

5.1.1 The operations necessary for the decommissioning and removal of the platform should be planned in advance, at the design stage, and included in the platform design package.

5.1.2 Removal operations are to be planned and executed according to Clause 19 of ISO 19901-6:2009.