

GENERAL SPECIFICATION

STRUCTURAL

GS EP STR 102

Design of offshore topside structure

Rev.	Date	Purpose of the revision
16	11/2016	§ 4.13.2 revised, § 4.14, Bibliography added, § 13 deleted
15	05/2015	§ Organisation change - January 2015
14	10/2014	§ 2, 4.10, 4.14.2, 4.16, 5.4 revised
13	09/2013	§ 4.10, 4.15.2, 4.17, 5.4 revised
00	02/2001	First issue

Owning entity: DSO/TEC	Managing entity: DSO/TEC/STR
Other Approving entity(ies):	

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 2 of 54

Contents

1. Scope	4
2. Reference documents	4
3. General design requirement.....	8
3.1 General principles	8
3.2 Importance of structural members.....	9
3.3 Air-gap	9
3.4 Splash-zone	10
3.5 Corrosion allowance	10
3.6 Minimum thickness	10
3.7 Maximum slenderness ratio of members.....	10
3.8 Connections	11
3.9 Hollow sections	14
4. Design loads and loading conditions (API section C)	14
4.1 Definition of loads and loading conditions	14
4.2 Gravity design loads	19
4.3 Environmental loads	23
4.4 Vortex shedding (wind)	24
4.5 Loads on stairs, walkways, outfitting	24
4.6 Topsides design loads due to floating support motions	24
4.7 Combination of loads for in-place design.....	25
4.8 Seismic loads.....	26
4.9 Fabrication and installation loads (API C5).....	26
4.10 Summary of loads factors for LRFD design.....	27
4.11 Vibration analysis.....	27
4.12 Design against explosion (Blast)	31
4.13 Fire	36
4.14 Blast & Fire sequence	37
4.15 Impact (Dropped objects and swinging loads).....	38
4.16 Lattice structures (flare booms and towers).....	39
4.17 Fatigue.....	39

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 3 of 54

5. Structural steel design (API sections D and E)	40
5.1 General	40
5.2 Structural modelling	41
5.3 Allowable displacements	41
5.4 Weights and weight monitoring	42
6. Structural component and systems (API Sect. H)	43
6.1 Deck design model (API H.1.2)	43
6.2 Lifting and handling appliances, except platform crane	43
6.3 Crane supporting structure	43
6.4 Pipe Supports	45
7. Selection of materials for offshore structures (API section I)	45
7.1 General	45
7.2 Through-thickness property (quality Z)	46
8. Detailed engineering documents (API section J)	46
8.1 General	46
8.2 Calculation notes	47
8.3 Content of the detailed engineering calculation notes	47
8.4 Drawings	48
9. Engineering provisions	50
10. Engineering supervision plan	51
11. Fabrication principles	51
11.1 Fabrication studies	51
11.2 Weight monitoring	51
11.3 Sea-fastening: miscellaneous	51
12. Specific requirements for floaters	52
12.1 Requirements for F(P)SO	52
12.2 Requirements for other floaters	53
Bibliography	54

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 4 of 54

1. Scope

This specification covers the design of offshore superstructures including all relevant appurtenances such as, but not limited to:

- Topsides and Modules
- Bridges
- Flare booms
- Flare towers
- Travelling crane and pedestal crane supports
- Walkways, stairways, ladders
- All installation appurtenances (padeyes, guides, docking guides)
- Living quarter structures.

The design shall be performed according to WSD ([API RP 2A-WSD](#)) or LFRD ([ISO 19901-3](#)), unless otherwise indicated in the present specification.

In all cases, the design principle (i.e. WSD or LRFD) shall be the same for all parts of the platform (jacket, deck, etc.), and for all conditions.

Materials for procurement, welding and associated inspections are covered by [GS EP STR 201](#), [GS EP STR 301](#) and [GS EP STR 304](#).

Fire protection provisions are not included in this specification. Passive fire protection design and installation is covered by [GS EP COR 353](#).

The jacket design shall be conducted in accordance to [GS EP STR 101](#), and shall utilise the same design principle (i.e. WSD or LRFD) as for the superstructures.

[GS EP STR 101](#) shall also be used for design of any topsides components that may be subjected to wave and current forces.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

The structural design superstructures shall be conducted in accordance to the reference documents including codes and standards defined hereafter.

Where national regulations exist, their provisions and those of the standards and codes to which they refer shall apply, supplementing or amending the provisions of this document, subject to prior Company approval.

If there are no national regulations covering all or part of the subject of this document, the reference documents shall be strictly applied, as supplemented by the provisions of this specification and the project documents.

In case the design of a particular structure or part of a structure is not covered by any of the listed reference documents, Contractor shall propose the use of a reputed and fit for purpose international code or regulation, subject to Company approval.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 5 of 54

In all cases, Contractor shall avoid to mix the requirements of several different codes or regulations when designing a particular item of a structure.

Only the main reference documents are mentioned; the Contractor shall be responsible for complying with all secondary reference documents dealing with the subject of this document.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

Reference	Title
AISC 325	Steel Construction Manual
AISC 360	Specification for Structural Steel Buildings
API Bull 2U	Bulletin on stability design of cylindrical shells
API Bull 2V	Bulletin on design of flat plate structures
API RP 2A-WSD	Planning, Designing, and Constructing Fixed Offshore Platforms-Working Stress Design
API RP 2FB	Recommended Practice for the design of Offshore Facilities Against Fire and Blast Loading
API SPEC 2C	Offshore Pedestal-mounted Cranes
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
AWS D 1.1/D 1.1M	Structural Welding Code - Steel
Baker WE, Cox PA, Westine PS, Kulesz JJ & Strehlow RA	Explosion hazards and evaluation (1983)
BS EN 1993-3-1	Eurocode 3. Design of steel structures. Towers, masts and chimneys. Towers and masts
CAP 437	Standards for Offshore Helicopter Landing Areas
DNV-OS-A101	Safety Principles and Arrangements
DNV-OS-E401	Helicopter decks (section 3 - structural strength)
DNV-RP-C203	Fatigue Design of Offshore Steel Structures
DNV-RP-C204	Design against Accidental Loads
DNV-RP-C205	Environmental conditions and Environmental Loads

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 6 of 54

Reference	Title
EN 10164	Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions
EN 10204	Metallic products - Types of inspection documents
EN 1337 (All parts)	Structural bearings - All parts
EN 1991 (Parts 1-2; 3; 1-6)	Eurocode 1: Actions on structures – Parts 1-2 ; 3 ; 1-6
F.E.M. 1.001 or equivalent	Rules for the calculation of hoisting equipment
HSE OTO 2001/070	The structural design of helidecks for offshore installations.
HSE RR285	Protection of piping systems subject to fires and explosions
ICAO - Annex 14	Volume II Heliports
ISO 12944-3	Paints and varnishes. Corrosion protection of steel structures by protective paint systems - Part 3: Design considerations Annex C: Minimum dimension for narrow spaces between surfaces
ISO 19900	Petroleum and natural gas industries - General requirements for offshore structures
ISO 19901 (All parts)	Petroleum and natural gas industries - Specific requirements for offshore structures - All parts
ISO 898-1	Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs with specified property classes - Coarse thread and fine pitch thread
OREDA	Offshore reliability data handbook
OTH 92 379	A criterion for assessing wind induced crossflow vortex vibrations in wind sensitive structures

The Company recognizes [ISO 19900](#) and [ISO 19901](#) as a source of sound recommendations on good practice. However, in some cases the requirements of these International Standards do not comply with the requirements of the Company's General Specifications. Furthermore, there exists within these International Standards the requirement for the owner or operator to define certain parameters which may override suggested default values.

In general terms, the requirements of formally issued [ISO 19901](#) shall be applicable in context to the design of new structures for Company and to the insurance that operations are performed within defined and recognized safety/confidence levels where these requirements are additional to or are more onerous than the requirements stated in the Company's General Specifications and Project Particular Specifications. In this context, the default values of parameters recommended by these International Standards shall apply, unless more onerous values are stipulated within the Contract documents.

Any other proposal based on the content of these International Standards shall be subject to Company approval.

Design of offshore topside structure

Rev.: 16

Effective date: 11/2016

Page: 7 of 54

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

The provisions of this document shall be applied in the light of the supplementary documents supplied by the Owner, including:

- Country specificity appendices
- Particular specification
- Data sheets
- Articles and conditions; list of tasks
- Quality assurance provisions.

Reference	Title
GS EP COR 222	Fusion Bonded Epoxy (FBE) external coating for pipelines
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 353	Design and application of passive fire protection coatings
GS EP LSO 110	Environmental effects considerations for helidecks
GS EP MEC 300	Noise and Vibration of Rotating Machine Packages
GS EP SAF 221	Safety rules for buildings
GS EP SPS 009	Corrosion protection of subsea stations
GS EP STR 001	Weight monitoring and weighing offshore and onshore units
GS EP STR 002	Crane for fixed offshore installations
GS EP STR 003	Crane for floating offshore installations
GS EP STR 004	Riser / Umbilical Pulling Rig, Pulling and Mooring Winches
GS EP STR 005	Lifting Appliances other than cranes and winches
GS EP STR 006	Requirements for the design, fabrication and testing of Overhead Travelling Cranes
GS EP STR 100	Offshore steel structures - General
GS EP STR 101	Design of offshore jacket and subsea structures
GS EP STR 103	Design and fabrication of skids and equipment supporting structures
GS EP STR 104	Design and fabrication of technical cubicles for offshore and onshore oil installations
GS EP STR 201	Materials for offshore steel structures
GS EP STR 202	Cast materials for steel structures

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 8 of 54

Reference	Title
GS EP STR 203	Forged materials for steel structures
GS EP STR 301	Fabrication of offshore steel structures
GS EP STR 304	Fabrication of Welded Plate Girders (W.P.G.) and Box Girders (B.G.)
GS EP STR 401	Loadout, seafastening, transportation and installation of offshore structures
GS EP STR 901	Design rules and construction standards for ancillary structures of offshore and onshore installations
GS EP STR 902	Pultruded fire resistant fibre reinforced plastic floor grating

3. General design requirement

3.1 General principles

The following principles shall be taken into account in the design of structures:

- Principles for load-out, transportation, installation, lifting, launching or for any particular phase or condition and accidental conditions, which has a major impact on certain component of the structures, shall be integrated in the design at the very beginning of the design phase.
- Hook-up works shall be reduced to a minimum and shall be made as easy as possible. Consequently, each element, even if of secondary importance, shall be analysed in order to maximise the amount of work to be carried out on the fabrication site.
- Structure shall be detailed to avoid corrosion and wear and minimize fatigue. Inspection and maintenance works of installed structures shall be easily accomplished. Maximum access to all elements and at all phases of platform life should be provided. Recommendations of [ISO 12944-3](#) Annex C shall be considered for minimum dimensions for narrow spaces between surfaces. For flare towers, heat resistant materials shall be used and bolts avoided.
- Unnecessary or duplicated permanent loads (skids + flooring underneath, modules + flooring underneath, etc.) shall be avoided.
- Safety shall be considered as priority and shall be taken into consideration from the beginning of the design, including for the temporary phases (load-out, transport and installation). Particular attention shall be paid to accessibility, circulation routes, escape routes, muster areas, partitions, fire resistance, finish materials, etc.
- Future extensions and additional loads (if any such as Company reserve) shall be considered and the consequent design arrangements shall be made.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 9 of 54

3.2 Importance of structural members

3.2.1 Structural members

The structural members of the resisting structures are distributed into three categories of importance, mainly in regard of the consequences of their possible failure during platform production or during installation of constituting parts of the platform (lifting of packages, etc.), as defined in [GS EP STR 100](#).

This distribution of structural members into categories of importance shall be submitted to Company for prior approval.

3.2.2 Non structural members

Accessory and finishing elements, i.e. not participating in the overall strength of the platform structures (walkways, handrails, stairs, ladders, grating, flooring, etc.) constitute a class separate from that of Structural Members defined above.

3.3 Air-gap

The bottom of the lowest superstructure (deck) or piece of equipment shall be located at an elevation such as to provide a clearance “air-gap” above the highest foreseeable wave crest elevation superimposed on the maximum surge height plus the normal Mean High Water Springs (MHWS) (or HAT if required by project documents).

Unless stipulated otherwise, the air-gap shall be taken as 1.50 m minimum from the lowest part of the structure or piece of equipment, and shall also take into account any known or predicted long term seafloor subsidence.

100 years return period wave crest elevation shall be used unless otherwise noted.

Whenever it is unavoidable to have a minor part of the superstructure or a piece of equipment located within the air-gap defined above, wave loads shall be taken into consideration on this part of the structure or piece of equipment. However they will not be cumulated to the global wave loads acting onto the jacket and the foundations unless noted otherwise in the project specification.

Local verification of this part of the superstructure or piece of equipment, and its connection to the rest of the structure, shall also be carried out.

These wave forces affecting the items located in the air-gap may be evaluated as per [API RP 2A-WSD](#), section 2.3.4g.

In case of large equipment located in the air-gap, Company may request to consider global wave load effect (i.e. effects on deck, jacket and pile design).

It is also a requirement unless waived by Company that the main topside structure is not struck by the crest of a 1,000-year return (positive air gap).

In addition, for a rare-event wave of 10,000-year return all resulting forces shall be considered in the global analysis to demonstrate no progressive collapse, and that water doesn't threaten personnel's life or damage pipes and other equipment which may lead to environmental damage.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 10 of 54

3.4 Splash-zone

The splash-zone to be considered for structural design shall extend between:

- The crest level of the 100 years wave superimposed on the maximum surge height plus the normal Mean High Water Springs (MHWS)
- Below the Lowest Astronomical Tide (LAT) minus 3 meters or the annual swell trough whichever is the greater.

3.5 Corrosion allowance

Unless otherwise specified in the particular specifications, a corrosion allowance equal to 6. mm shall be added to the thickness of the special or first category members located in the splash zone including deck legs and transition pieces.

A corrosion allowance of 3 mm shall be added to the thickness of the bottom chords of the bridges and of the first vertical panel at both ends. Where the inspection and maintenance access is not possible, a corrosion allowance of 6 mm shall be added.

For fatigue analyses, the corrosion allowance may be considered equal to one half of the above values (3 mm).

Corrosion allowance for subsea structures shall be defined in the project documents.

3.6 Minimum thickness

The minimum thickness shall be:

- 8 mm for special and first category components
- 5 mm for other components
- 3.7 mm for handrails.

3.7 Maximum slenderness ratio of members

The maximum slenderness ratio for deck, flare, mast tubular members shall be limited to 120. For sensitive non-redundant members Company may limit the maximum slenderness ratio to 90. For deck, flare and mast located in particular seismically active areas, Company may limit the maximum slenderness ratio to 80 ([API RP 2A-WSD](#) Earthquake design requirements).

In general term the design of the tower and mast will be carried in compliance with requirements of [BS EN 1993-3-1](#) Standard, for flat plate structures & cylindrical shells in compliance with the requirements [API Bull 2U](#), [API Bull 2V](#) and the requirements of this specification.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 11 of 54

3.8 Connections

3.8.1 Welded connections

The connections shall be designed in such a way that:

- They shall allow for a direct, straightforward and simple load transfer from one structural member to another, avoiding stress concentration and induced bending stresses as far as possible.
- Their fabrication shall be as simple as possible; constructibility and welding access shall be particularly verified during design.
- Notching effects are eliminated and all transitions shall be appropriately tapered and radiused.
- Corrosion is reduced to a minimum. This means avoiding shapes or arrangements that induce retention or ponding of water or hydrocarbons, in order to avoid hazards and ease inspection and maintenance/painting.
- The minimum fillet weld leg size shall be 5 mm.
- Contractor shall perform the necessary detailed calculations to optimise the minimum fillet welds size between the web and the flanges of the WPG taking into account the maximum shear forces along the free span between the nodes or end supports for all the pre-service (erection, load-out, transport, installation) and in-place conditions (fatigue, seism, blast & fire, etc.).
- The minimum fillet weld throat size shall not be less than the max of (minimum calculated throat; web thickness (w)/4; 1 mm + square root of the flange thickness in mm; 3.5 mm). For Special category the minimum fillet weld throat size shall be w/2 unless otherwise specified.
- Unless otherwise noted in drawings, the weld throat shall be equal to half of the web thickness.
- Locally under point loads or where important shear forces exist, additional fillet weld reinforcements are allowed with a smooth transition and stiffeners shall be added where necessary.
- At the main nodes, the welds between the web and the flanges should be full penetration unless otherwise documented.
- Main diagonals connections by slotted gusset plates are prohibited for diameter above 12". For braces less or equal to 12" necessary fatigue assessment shall be provided taking account SCF and out of plate bending.

All structural connections, including stresses in welds and with due account for stress concentration caused by local stiffening, shall be justified by calculations.

Connections shall be designed to resist the acting load with a minimum of 50% of the attached member's effective strength.

Through stress shall be avoided when possible, otherwise use of Z35 steel shall be considered (see § 7.2).

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 12 of 54

3.8.2 Bolted connections

1. Bolted connections between structural members pertaining to special or first category shall be avoided as far as possible. Bolts in tension should not be used for lift points and bolted connections should not be located in splash zones or zones otherwise subject to intermittent wetting, or in other zones where inspection is difficult or impossible. If such connections are unavoidable their use and detailing shall be subject to Company Approval.
2. Mechanical/locking devices of nuts shall be provided for bolted connections between structural members pertaining to special or first category, to masts, to equipment superstructures, to vibrating equipment, etc.
3. In case bolted connections have to be implemented, they shall be designed according to [AISC 325](#):
 - Part 7: Design considerations for bolts
 - Part 9: Design of connecting elements
 - Part 10: Design of simple shear connections
 - Part 11: Design of flexible moment connections
 - Part 12: Design of fully restrained moment connections
 - Part 13: Design of bracing connections and truss connections
 - Part 14: Design of beam bearing plates, column base plates, anchor rods and column splices
 - Part 15: Design of hanger connections, bracket connections, and crane rail connections
 - Part 16: Specifications and Codes:
 - [AISC 360](#) chapter J: connections, joints and fasteners
 - RCSC Specification for structural joints using [ASTM A325](#) or [ASTM A490](#) bolts for High Strength (HS) bolting
4. Bolting shall generally be in carbon steel to [ASTM A307](#), [ASTM A325](#) or to [ISO 898-1](#). [ASTM A490](#) bolting can be used where it is confirmed that bolt materials are limited to have an actual yield strength no higher than 950 MPa and hardness no higher than HRC 34.
5. The use of High Strength bolts shall be subject to prior approval of the Company.
 High Strength bolts shall be in full compliance with the testings and requirements of [ASTM A325](#) or [ASTM A490](#). The mechanical properties shall be subject to sample inspections using the "shipping lot method" and a copy of the inspection test report for each shipping lot shall be furnished to the Purchaser and Company.
 Use of HS bolts subject to shearing stresses shall not be permitted in non-sheltered areas opened to projections or dripping of liquids. Utmost care shall be taken to ensure assembly resistance to corrosion.
6. Where components in materials other than carbon steel are joined with bolts then the bolting material should match so far as possible. Company approval for such bolts shall be gained.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 13 of 54

7. Connections shall be classed as "pretensioned joints" or "slip critical joints" where so required by section J.1-10 of the [AISC 360](#) and/or section 4.3 of RCSC Specification for structural joints using [ASTM A325](#) or [ASTM A490](#) bolts. Drawings of bolt connections shall in all cases identify the joint type as "snug-tightened", "pretensioned" or "slip-critical" as applicable, and shall define associated requirements.
8. Fabrication procedures for Company Approval shall be developed accordingly, to define procedures for bolt handling, coating provisions and joint assembly.
9. Anti-corrosion measures shall follow the following requirements unless noted otherwise:
 - For areas in and above of the splash zone, the bolting shall be galvanized and then painted. All threaded components of the fastener assembly must be galvanized by the same process.
 - For areas in the splash zone and below, all contact surfaces shall be painted even for slip resistant joints with a reduced friction coefficient.
 - For immersed zones, the bolting shall be painted at least for corrosion protection during fabrication, and painted or oiled during storage. Electrical continuity shall be provided with serrated washers or similar to be approved by Company.
 - Zinc plated bolts shall be avoided due to QA/QC problems (hydrogen embrittlement).

Anti-corrosion measures shall have prior approval of the Company.

10. For joints with controlled tightening bolts:
 - The ratio of the Tightened Length (TL) to the bolt diameter (d) shall not be less than 5 ($TL/d \geq 5$).
 - The friction coefficient(s) between nut and washer, measured by bolt manufacturing mill on the supplied production lot(s), shall be reported on bolt mill certificate(s) and on bolt individual lot packing.

Note: The friction coefficient is defined as follows:

$$K = 1000 C / (d \times P \times 0.88)$$

Where:

- K is the friction coefficient
 - C (in N.m) is the torque to be applied to obtain a pre-load P (in N) in the bolt
 - d (in mm) is the nominal bolt diameter
11. Only three clearly different bolt diameters shall be used per structure.
 12. The responsible party for supply shall provide full certification in accordance with the reference standard, meeting Type 3.1 of [EN 10204](#) or equivalent.
 13. Bolting in clamps for risers, riser bend restrictors, and similar applications shall comply with [GS EP SPS 009](#) (§ 5.1).

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 14 of 54

3.8.3 Pin and sliding connections, and structural bearings

All connections designed to permit rotation and or translation shall be designed to avoid corrosion and abrasion. All such components shall be designed to be fully inspectable and replaceable in service.

For connections of this type, the designer shall specify on the construction drawings all necessary tolerances to ensure satisfactory fit-up and operational performance.

Corrosion and abrasion resistant materials shall be used in such locations where integrity of coatings cannot be guaranteed.

There shall be a minimum factor of safety of 2.0 against failure by fatigue or wear during the design life of the installation.

All joints around reinforcing cheek plates and similar shall be fully welded.

Bearings for support of load-bearing structure shall comply with [EN 1337](#).

3.9 Hollow sections

Hollow sections that cannot be serviced from the inside due to their dimensions or their location, are to be made watertight by closure plate and welding.

Manholes or trapdoors giving access to normally closed spaces (e.g. crane pedestal) shall be equipped with leak-proof seals.

4. Design loads and loading conditions (API section C)

In general, the design of an offshore steel structure shall be carried out using the definition of loads and loading conditions as per [ISO 19901-3](#) or [API RP 2A-WSD](#), section 2, with the additional requirements stated in the following paragraphs and in [GS EP STR 100](#).

4.1 Definition of loads and loading conditions

The following loads and any dynamic effect resulting from them shall be used to develop the loading conditions to be considered for the design of an offshore steel structure.

4.1.1 Definition of loads

4.1.1.1 Dead loads

Dead loads are the weights of the platform structure, appurtenances, and any permanent equipment, which do not change with the mode of operation, such as (but not limited to): steel structure, piles, grout, ballast, hydrostatic forces, permanent equipment, etc.

4.1.1.2 Live loads

Live loads are the gravity loads, which may change during the operation of the platform or from one mode of operation to another mode of operation, such as (but not limited to): weight of drilling equipment, weight of equipment which may be added or removed, weight of consumable supplies, weight of production/utilities equipment and piping contents, blanket live loads as defined in § 4.2.4.2, forces exerted on the structure during operations such as drilling, material handling, vessel and helicopter landing, crane operation, etc.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 15 of 54

4.1.1.3 Environmental loads

Environmental loads are imposed on the platform by natural phenomena such as wind, wave, current, tide, earthquake, snow and ice, and soil movement. Environmental loads shall be anticipated from any direction, unless otherwise demonstrated.

4.1.1.4 Dynamic loads

Dynamic loads are the loads due to the response to an excitation of a cyclic nature or due to an impact or due to the sudden application of a load (impulse type). Dynamic loads may be induced by waves, wind, current, earthquake, crane or lifting equipment operation, drilling operation, boat or helicopter landing, rotating equipment, blast, etc.

4.1.1.5 Construction loads

Construction loads are the loads resulting from fabrication, load-out, transport and installation of a platform, and shall be considered in the design as further indicated.

4.1.1.6 Accidental loads

Such loads result from abnormal or accidental conditions. The project qualitative risk analyses may define probabilities of occurrence to be considered in determining the intensity of such accidental loads. In the absence of such project-specific assessment, all accidental loads shall be determined on the basis of a probability of occurrence equal to 10^{-4} per year.

Depending on the installation, the following accidental load conditions may require to be considered for the whole or part of the installation:

- Abnormal environmental load (e.g. 10000 Years return period)
- Extreme earthquake
- Fire
- Explosion
- Dropped object, swinging loads, etc.
- Ship impact
- Strong vibration caused by explosion or impact
- Impulse loads caused by broken moorings or lifting wires
- Compartment flooding of floating structures leading to vessel inclination.

4.1.2 Definition of loading conditions

The loads defined in § 4.1.1 above shall be combined to develop the appropriate loading conditions such as to produce the most severe effects on the structure.

Operating environmental load conditions are those, which are not severe enough to restrict normal platform operation.

Design environmental load conditions are those resulting from the selected design events (i.e. extreme environmental conditions), which may induce a restriction of platform operation.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 16 of 54

The design of an offshore structure shall consider load conditions combining environmental loads with appropriate dead and live loads in the following manner:

- Operating environmental load condition (including dynamic loads if any) combined with dead loads and maximum live loads (including dynamic loads if any) appropriate to normal operation of the platform.
- Operating environmental load condition (including dynamic loads if any) combined with dead loads and minimum live loads (including dynamic loads if any) appropriate to normal operation of the platform.
- Design (Extreme) environmental load condition (including dynamic loads if any) combined with dead loads and maximum live loads (including dynamic loads if any) appropriate for combination with extreme environmental condition.
- Design (Extreme) environmental load condition (including dynamic loads if any) combined with dead loads and minimum live loads (including dynamic loads if any) appropriate for combination with extreme environmental condition.
- Earthquake environmental condition (including dynamic effects) combined with dead loads and live loads as detailed in § 4.8.
- Temporary load condition occurring during fabrication: load-out, transport, installation shall consider combinations of dead loads, maximum temporary loads (including dynamic loads if any) and appropriate environmental loads (including dynamic loads if any).
- Accidental loads such as in an explosion shall be combined with all normal operating loads.
- The installation shall also be assessed for damaged conditions after an accidental event to ensure that it may be safely restored. The damaged structure shall be assessed to ensure no progressive collapse under 1-year return environmental conditions, unless noted otherwise in the project particular specification.

Environmental loads shall be combined in a manner consistent with the probability of their simultaneous occurrence during the loading condition being considered.

Earthquake loads shall be applied on the structure as a separate environmental condition, and shall not be cumulated with wave, current and wind loads.

Operating environmental condition should represent a moderately severe condition at the platform location; typically, a 1-year return period wave, current and wind shall be used for operating environment, to be confirmed in the particular specification, or unless specified otherwise by national/local regulations.

Extreme environmental condition shall be generated by the 100-year return period wave, current and wind, to be confirmed in the particular specification, or unless specified otherwise by national/local regulations.

Earthquake environmental condition is detailed in the particular specification, or unless specified otherwise by national regulations.

General Specification		GS EP STR 102
Design of offshore topside structure		
Rev.: 16	Effective date: 11/2016	Page: 17 of 54

4.1.3 Modelling of loads and loading conditions

In view of their combinations such as to represent loading conditions, the loads shall be classed according to the following principles:

4.1.3.1 Elementary load case

The elementary load case shall be defined as a set of indivisible loads of the same type acting concomitantly on a structure.

As such, dead weights and live or operational loads shall be splitted in different elementary load cases, such as but not limited to:

- The dead weight of the primary structures
- The dead weight of the secondary structures
- The dead weight of the itemised empty piping
- The weight of the fluid content in the piping
- The weight of the itemised mechanical equipment
- The dead weight of the bulk electrical equipment
- The loads due to operating waves oriented at 90°
- The blanket live load at cellar deck
- The dead weight of the platform crane
- The operating load of the platform crane (force + momentum).

4.1.3.1.1 Traceability of elementary loads

Both calculation note and computer model file shall fully document and trace in detail the origin of each and every load input in the model. As such, individual loads pertaining to each piece of itemised equipment shall be related to the equipment reference number.

Calculation notes shall include elementary loading sketches detailing for each equipment the magnitude of the load, the identification of the structural members supporting the load the location of the load on the structural member and the identification of the equipment. The above is also applicable to the main itemised piping supports, electrical cables supports, etc.

Additionally, loading diagrams summarising all gravity loads per level for the platform, including dead weights, operational loads and live loads for all itemised and bulk equipment, blanket live loads, shall be issued and updated by the Contractor throughout the complete duration of the project.