

GENERAL SPECIFICATION

STRUCTURAL

GS EP STR 401

**Loadout, seafastening, transportation and
installation of offshore structures**

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1. Scope

This General Specification defines the conditions and methods which are required by Company for loadout, sea-fastening, transportation and installation of offshore fixed steel structures, topsides of floaters and subsea structures.

The specification applies to "conventional" fixed offshore structures, such as:

- 3, 4, 6 or 8 leg piled jackets installed by crane
- Launched 4 or 8 - legged piled jackets
- Decks (whether pre-equipped or not) installed by lifting or float-over
- Modules
- Subsea structures (such as FLET, FTA, ILT / ITA, PLEM / PLET, manifold modules, suction piles, mooring anchors, etc.).

This specification does not cover in details the installation of self-launched components such as columns, jack-ups, gravity-based platforms, or mooring line pre-lay and hook-up etc. If necessary, these will be covered by a particular specification however all relevant requirements from this specification have to be applied

Special transportation such as dry tows of hull, TLP, semi-submersible, jack-up, etc will be covered by a particular specification however all relevant requirements from this specification have to be applied.

This specification shall be read in conjunction with the Project Particular Specification.

2. Reference documents

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

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
API RP 2A-WSD	Planning, Designing, and Constructing Fixed Offshore Platforms-Working Stress Design
DNVGL-OS-E303	Offshore fibre ropes
DNVGL-ST-N001	Marine operations and marine warranty (Edition 2016-06)
DNV-RP-H103	Modelling and Analysis of marine operations
EN 12385 (All parts)	Steel wire ropes - Safety - All parts
EN 13414 (All parts)	Steel wire rope slings - Safety - All parts
EN 1492 (Parts 1; 2)	Textiles slings - Safety - Parts 1; 2
I.A.L.A.	International Association of Lighthouse Authorities regulations

Reference	Title
IMCA M 179	Guidance on the use of Cable Laid Slings and Grommets
ISO 19900	Petroleum and natural gas industries - General requirements for offshore structures
ISO 19901 (Parts 6; 7)	Petroleum and natural gas industries - Specific requirements for offshore structures – Parts 6; 7
ISO 2408	Steel wire ropes - Requirements
ISO 4309	Cranes - Wire ropes - Care and maintenance, inspection and discard

Company recognizes [ISO 19900](#), and/or [DNVGL-ST-N001](#) as a source of sound recommendations on good practice. However, in some cases the requirements of these documents do not comply with the requirements of the Company's General Specifications. Furthermore, there exists within these documents, 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 19900](#) and/or [DNVGL-ST-N001](#) shall be applicable in context to the design of new structures for Company and to the insurance that marine 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 [ISO 19900](#) and/or [DNVGL-ST-N001](#) shall apply, unless more onerous values are stipulated within the Contract documents.

Any other proposal based on the content of [ISO 19900](#) and/or [DNVGL-ST-N001](#) shall be subject to Company approval.

Total General Specifications

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

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP GEO 504	Comprehensive evaluation of metocean conditions
GS EP GEO 506	Meteorological and Oceanographic Forecasting
GS EP LSO 201	Towing of Watercraft
GS EP LSO 202	Personnel transfer between watercrafts and between watercrafts and offshore structures
GS EP POS 001	Offshore surface positioning works
GS EP POS 002	Subsea positioning works

Reference	Title
GS EP POS 003	Land surveying and positioning works
GS EP SPS 027	WORO spread minimum requirements
GS EP STR 001	Weight monitoring and weighing offshore and onshore units
GS EP STR 005	Lifting Appliances other than cranes and winches
GS EP STR 100	Offshore steel structures - General
GS EP STR 101	Design of offshore jacket and subsea structures
GS EP STR 102	Design of offshore topside structure
GS EP STR 108	Requirements for evaluation of finite elements analysis and results
GS EP STR 201	Materials for offshore steel structures
GS EP STR 202	Cast materials for steel structures
GS EP STR 203	Forged materials for Offshore 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 402	Anchorage for support vessel on an offshore site
GS EP STR 404	Marine aspects for load-out, transportation and installation of offshore and onshore structures
GS EP STR 411	Crane and transport operations onshore
GS EP STR 431	Installation of piles for offshore steel structures. Driven piles
GS EP STR 432	Installation of piles for offshore steel structures. Drilled and grouted piles
GS EP STR 661	FPSO - Design requirements for mooring and anchoring systems
GS EP STR 901	Design rules and construction standards for ancillary structures of offshore installations

3. Terms and Definitions

For the purpose of this document, the following terms and definitions apply.

ACFM	Alternating Current Field Measurement
Barge	The floating vessel on which the object is transported. For this specification, the term 'barge' can be considered to include cargo barge, vessel or ship where appropriate.
Budget weight	Estimated object weight + Company reserve
CSBL	Calculated Sling breaking load

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CGBL	Calculated Grommet breaking load
FLET	Flow Line End Termination
FTA	Flowline Tee Assembly
HMPE	High Modulus Polyethylene
ILT / ITA	In Line Tee / Inline Tee Assembly
Link beam	The connecting beam between the quay and the barge
MBL	Minimum Breaking Load
MSF	Main Support Frame
Object	The offshore structure to be successively loaded out, transported and installed.
PLEM / PLET	Pipe Line End Manifold / Pipe Line End Termination
PPE	Personal Protective Equipment
Skidbeam	A system of steel structural beams on the barge, on which the object is loaded via the skidshoes.
Skidshoe	A bearing pad attached to the object that engages in the skidway and carries a share of the vertical zone.
Skidway	A system of structural beams (concrete and/or steel) or rails, on the quay, on which the object is loaded via the skidshoes.
SWL	Safe working load: The maximal dynamic load calculated as per the applicable factors that equipment can raise lower or suspend under particular service condition.
TLE	Tugger line effect
Trailer	A system of steerable wheels, connected to a central spine beam by hydraulic suspension which can be raised or lowered.
Weather window	period of time, sufficient in length to safely carry out a marine operation, for which forecast environmental conditions remain below prescribed limiting operational environmental criteria.
WLL	Working load limit: The maximal load that equipment is designed to raise lower or suspend. The WLL does not consider the particular service condition which may affect the final rating of the equipment (see SWL here above).

4. General considerations

4.1 Safety and Health

In order to protect the personnel and all equipment, the Contractor shall take all the necessary and preventive actions to fulfil the safety requirements in particular for the use of Personnel Protective Equipment (P.P.E.), safety harness, scaffoldings correctly erected and in good order, correct lightning of working areas, safety buoys along quay side or cargo barge/ vessel side shells,

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a minimum of 150% life raft capacity with respect to the POB involved in the operation and additional visitors and workers to be identified, etc.

In particular, life vests shall be worn during the operations along the quay and on the vessel for the loadout, seafastening, transportation and installation.

Only authorized persons involved in the marine operation are allowed on the cargo barge or vessel deck where life vests are mandatory.

For long duration operations of more than six hours, a safe rest area with sufficient number of tables, chairs, benches, lightning, camp beds, etc., shall be provided with sufficient drinks and meals. In addition, decent mobile chemical cabin toilets or equivalent in sufficient number (one cabin for 20 persons maximum) shall be provided for all the involved personnel.

4.1.1 Risk management

For each marine operation (load-out, transport, installation, float-over or lifting...) addressed in this specification a dedicated Hazard Identification session (HAZID) shall be performed.

If a marine operation is aborted or a mechanical failure occurs, a dedicated formal root cause analysis shall be performed and approved by Company.

4.1.2 Personal transfer

Surfer/boat landings shall be provided to allow for a safe access on the cargo barge/vessel on **both sides** according to **GS EP STR 901**. Trial fitting and erection sequence will be performed at yard before the sail away. Air/electrical winches shall be used to facilitate and expedite the erection at site. Manual chain blocks will be avoided in particular for long pulling lengths/heights.

Personnel transfer between watercrafts and between watercrafts and offshore structures shall be organized as per **GS EP LSO 202**.

A Personal transfer plan has to be developed and approved by Company.

Any equipment used for personnel transfer shall be inspected and function tested with load every six (6) months and baskets shall be inspected every six (6) months.

4.2 Structural design principle

Plastic design shall not be allowed.

For each phase, either Working Stress Design (WSD) or Load Resistance Factor Design (LRFD) philosophies may be used. These approaches shall however not be mixed.

For pre-service analyses, where the 1/3rd increase on Basic Allowable Stress (BAS) is not allowed in WSD format, the Usage Factor shall be limited to 0.87 (UF/Material Factor: 1/1.15) (for LRFD analysis (ULS conditions).

For any finite elements analysis, the requirements of **GS EP STR 108** is applicable.

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4.3 Equipment and re-used steel components

4.3.1 General

All Material and accessories intended to be used for installation operation shall be submitted to Marine Surveyor and Company for approval.

- All equipment and re-used steel components to be used shall be in good order.
- For loadout or lifting operation using strand jacks system or equivalent, all cables shall be brand-new and clean before the operation. At least one full spare strand jack unit with brand-new cables shall be provided.
- Prior to any re-use, all equipment or steel components such as, but not limited to, substructures, skid beams, barge grillage, spreader frames/beams, jacking/pulling systems, deployment winches etc. shall be submitted to Company approval.
- An associated inspection program shall be submitted to Company approval. In particular, it shall be developed in line with, but not limited to, **GS EP STR 201** Table 4.1 and **GS EP STR 301** sections 10.2 and 15 requirements. When applicable, relevant requirements of **GS EP STR 202**, **GS EP STR 203**, and **GS EP STR 304** shall be considered.
- Material certificates shall be supplied.
- All bolts shall be new at each stage. Re-use of bolts is strictly prohibited.
- Equipment and jacking system maintenance, cocooning and protection during fabrication and transportation have to be performed by skilled qualified personnel, and in accordance with the schedules and instructions supplied by Manufacturers.
- Equipment and jacking system testing and inspections shall be carried out by appropriate skilled and qualified personnel.

4.3.2 Hydraulic jacking system

In addition to the above requirements (see section 4.3.1) the following shall apply to hydraulic jacking systems (used for loadout floatover or other operations):

- Any re-used/not brand-new jack or hydraulic power unit (HPU) shall be completely refurbished with new gaskets and seals.
- At least one spare jack for each type and one spare HPU shall be provided and kept immediately available with sufficient spare oil quantity at fabricator site and at offshore site.
- In presence of MWS, of Company and a Certifying Authority appointed by the Contractor and approved by Company, performance and calibration tests shall be performed for all the jacks and HPUs with new and clean oil and lubricants.
- After tests, the used/contaminated oil shall be analysed and replaced by new oil compatible for the long storage and idle period.
- A long duration running test of at least 72 hours shall be performed to simulate the degradation of the oil quality and system performance with respect to the running time, oil

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temperature, heavy jacking operating loads and relevant climatic conditions at fabricator and offshore sites (if relevant).

- In case of use of the jacking system for distinct operations (test, weighing, loadout, floatover...), the used/contaminated oil shall be analysed and replaced if necessary by new oil in between each operations.
- A detailed testing, operating, maintenance and cocooning manual shall be provided as well as the relevant Failure Mode Effect Analysis (FMEA) of the full hydraulic jacking system and control system.

4.3.3 Load tests and test intervals

Thorough visual inspection and functional load test intervals shall not exceed one year.

A new test shall be made in case of major repair or replacement of an essential part, or in case of a modification or a reassembly.

For jacking, lifting, pulling or pushing equipment, load tests shall be performed and witnessed by a Third Party Authority, the MWS and Company.

4.3.4 Communication

Communication systems and plans during marine operation shall be clearly identified and approved by Company. The following points have to be defined:

- Radio channel
- Telephone and out-of-hours numbers
- E-mails.

Contractor shall provide sufficient internet access to Company team (at yard or on board vessel) (at least 2 Mbps per Company personal).

4.3.5 Consumable, spare parts and tooling

Contractor shall make immediately available at offshore site/yard all the necessary additional spare parts and tooling (jacks, HPU, oil, etc.) to complete the job in a satisfactory and safe manner, accounting for every contingencies as identified in the planning phase.

4.4 Vessel

All nominated vessels will have to be accepted by Company. Refer to [GS EP STR 404](#).

4.5 Manning, Qualification, Training

Refer to [ISO 19901-6](#) section 5.7 and [DNVGL-ST-N001](#) section 2.8.2.

If the operation is a first of a kind or critical, training shall be organised and approved by Company prior to operations either through repetition of specific tasks or simulator workshop (in this case defined in the PPS).

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5. Organization, documentation and planning

5.1 Involved parties and responsibilities

5.1.1 Certification/Third Party authorities

The Project Particular Specification will define the Marine Warranty Surveyor, the Third Party Authority and/or Certification Authority and their respective scope and responsibilities during the operations covered by this General Specification.

In particular, the following will be defined:

- The authority responsible for checking/certifying the design of structures
- The authority responsible for checking/certifying the construction
- The authority responsible for checking/certifying one or all of the following operations:
 - Loadout
 - Seafastening
 - Transportation.
- The authority responsible for checking/certifying lifting and installation operations
- Interface tables detailing the scope, the interfaces and the documents to be submitted and approved.

5.1.2 Before loadout

Loadout certificate (to be issued by Marine Surveyor).

5.1.3 Before sail away

Sail away certificate (to be issued by Marine Surveyor).

5.2 Distribution of responsibilities

- The distribution of responsibilities and the interfaces between:
 - The Company
 - The various Contractors in charge of design, construction, loadout, ballasting, transportation and installation
 - The various Certification or Controlling Authorities
 are defined in the following tables. These typical tables shall be used unless otherwise specified in the Project Particular Specification or in the Contract.
- In particular, for the loadout, seafastening, transportation and installation, the Marine Warranty Surveyor appointed by the Company is responsible for checking / surveying / certifying as relevant the following:
 - The design including but not limited to design criteria, barge strength, stability, motions analysis, dynamic analysis during installation, etc.

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- The procedures and operation manuals
 - The marine and installation operations
 - The marine equipment and support vessels (derrick barge, HLV, cargo barge, ship, tug, etc.)
 - The necessary equipment/aids used for the different operations (jacking system, pushing/pulling system, water pumps, slings/shackles, moorings, towing equipments, etc.)
 - The transportation route
 - The environmental conditions
 - The weather forecast.
- The compliance with this specification and Company Approval does not release the Contractors and the Authorities in charge of the work, inspection and/or the certification, from their own responsibility.
 - Company will supply the Contractor with the permits required to access to and use the site selected for the installation of the structure.

Distribution of responsibilities

- | | |
|--|---|
| <ul style="list-style-type: none"> • Contractors in charge of: E Design Study F Fabrication/Construction W Weighing L Loadout (cargo displacement) B Ballasting during loadout (usually the loadout contractor for a barge or the Transportation contractor for a vessel) S Grillage and Seafastening T Transportation I Installation (lifting, floatover...) | <ul style="list-style-type: none"> • Other parties: C Company MWS Marine Warranty Surveyor TP Third Party/Control authority CA Certification Authority |
|--|---|

A = Approval - **R** = Review - **W** = Witness - **H** = Hold Point

C = concept design - **D** = detail design

P = Carries out or supplies means issue documents for document

and provide manpower, material, consumables and equipment (including spare) and perform the specified task

(*) Responsibilities of TP shall be defined in the Project Particular Specification.

1 - Loadout and weighing	Contractors							TP	CA	MWS	C
	E	F	W	L	B	T	I				
Verification of the loadout feasibility, layout of construction (height, quay water depth and height)	P	A									A
1.1 means of transport (cargo/launch/float-over...) and transport at yard entrance	R	R		R		P		(*)		A	A
1.2 Berthing and mooring of barge (including mooring lines) and movement within yard		P		A		R		(*)		A	R
1.3 Weight and centre of gravity calculated	P							(*)	R	R	R
1.4 Weight and centre of gravity measured during fabrication	R	P						(*)		R	R
1.5 Weighing	R	P	P				W/R	(*)	W/R	W/A	W/A
Barge/vessel structural strength information	R	R		R		P				A	A
Barge grillage and skid track for loadout	D	P		P		A					
All equipment and additional barge fixtures required to execute load-out	R	P		P	P	R				A	A
Temporary removal and reinstatement of fixed or installation related barge equipment required for loadout		P				A				R	R
Loadout operation		P		P	P			(*)		R	R
Tilt/skid interface with quayside	D	P		P	R						
Quay jacks for loadout if any	D		P								
Loadout certificate of approval								(*)		P	
Ballast plan and stability calculations (9.2)					P					A	A
Loadout manual (Appendix 2)	R	P	P	P	P	R	R		R	A	A
Loadout analysis (10.2)	P	A		R	R	R		(*)	R	A	A
Loadout operation		P	P	P	P	W		(*)		A	A
Loadout of accessories		P		P		W		(*)		A	A

2 - Grillage and Seafastening	Contractors							TP	CA	MWS	C
	E	F	W	L	S	T	I				
2.1 Barge grillage and seafastening documents defined in 11	C	R		R	P	D	A	(*)	A	A	A
2.2 Material, equipment and manpower for grillage, seafastening defined in 11.2.4.6		P			P	W	R	(*)		R	R
2.3 Technical file for seafastening (see 11.5)								(*)			
• Barge + packages	A				P	P		(*)	R	A	A
• Packages on barge	A				P	P		(*)	R	A	A
• Internal seafastening	D	P			P	R		(*)	A	A	A
2.4 Values to be taken into account for loading and seafastening calc. (see 11.2.1.4) Ballasting operations for grillage / seafastening and to reach transportation conditions	C					D		(*)	R	A	A
2.5 Barge internal reinforcement	A					P/R		(*)	A	A	R
2.6 Repair of areas damaged during loading and seafastening (see 11.2.4.6)	R	P			P	A		(*)		A	A

3 - Transportation	Contractors							TP	CA	MWS	C
	E	F	W	L	S	T	I				
3.1 Technical documents for transportation (sea-worthiness certificate, selected sea route, planning + personnel charts) GS EP STR 404						P		(*)		A	A
3.2 Transportation means (see 1.1)						P		(*)		A	A
3.3 Transportation documents (see 11)	P					P		(*)		A	A
3.4 Certificate of Sail Away (see 5.1.3) Transportation from yard to offshore site						P	A	(*)		P	A

4 - Offshore Installation (lifting, floatover, mooring hook-up...)	Contractors							TP	CA	MWS	C
	E	F	W	L	S	T	I				
The list here below corresponds only to activities where responsibilities may lead to discussions between Contractors entrusted with studies, manufacturing and transportation, and Contractors entrusted with installation. For the rest see sections 12 and 15.5.											
Marine operation simulator (navigation, DP, lifting...) workshop							P			W	W
Mooring analysis (barge, vessel, crane barge...)											
4.1 Pile make up and driveability analysis (see GS EP STR 431 and GS EP STR 432)	D						A	(*)	A	R	A
Pile driving equipment and drivability verification	C						D/P			A	A
Installation manual including procedures and marine analysis (see appendix Appendix 4)	R	R			A	A	P		A	A	A
Flooding equipments on the jacket	C	P					D			A	A
Flooding equipments on the installation vessel							P			A	A
4.2 Supply of slings, grommets and lifting shackles,	C						P	(*)		A	R
4.3 Installation of slings, grommets and lifting shackles (see 15.5.2.3)		P				A	A	(*)		A	R
4.4 Supply and installation of temporary access ways to attachment/operation areas	C	P					D/A	(*)		R	R
Floatover mooring lines on jacket	C	P					D			A	A
Fender system on jacket	C	P					D			A	A
4.5 Fitting-out of cargo-barge, lifting barge with necessary reinforcement, fenders, sheaves, anchoring points...						P	D	(*)		A	A
On-bottom stability analysis (refer to GS EP STR 101)	D						A			A	A

4 - Offshore Installation (lifting, floatover, mooring hook-up...)	Contractors							TP	CA	MWS	C
	E	F	W	L	S	T	I				
Lift points	D	P									
Spreader bars / frames	D	P					C			A	A
Preparatory work on existing platform	C	P					D/A			A	A
Operation Certificate of Approval										P	
Detailed design all the necessary float-over structures	C					P					
Supply, fabrication and erection of all the necessary float-over structures					P	P					
Installation manual (Appendix 4)					R	P				A	A
4.6 Mooring of cargo-barge						P	D/P	(*)		A	A
Weather monitoring during installation,							P			A	A
4.7 Cutting-off of sea-fastening						W	P	(*)		A	H
4.8 Installation operations							P	(*)		A	A
4.9 Return of cargo-barge						P		(*)		A	A
As installed survey and final documentation	C						P				

5.3 Documentation Planning

5.3.1 Design and planning phase

For major marine operations (load-out, transport sail-away, jacket installation, deck float-over, FPSO mooring hook-up, module offshore lift...) the following milestones shall be considered:

- **Four months prior operation:** Operation manual including procedure and the relevant engineering documentation has been issued to Company as per Appendix 1, Appendix 3, and Appendix 4 depending of the operation.
- **Two months prior operation:** HAZID is performed based on a Company and MWS approved operation manual.

All documentation shall be approved by Company, Marine Warranty Surveyor, third parties and authorities as relevant prior operation.

5.3.2 For tendering

The technical documents to be submitted includes, in particular:

- The principles of methods used for loading and barge grillage/sea fastening
- A description of the barges and tugs to be used for transport and installation

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- The principles of methods selected for the jacket, pile, deck and structure installation, including a list of the main items of equipment with their capacity (cranes, jacking system, hammers, drilling rigs, etc., a set of sketches showing the operation with clearances...
- A general time schedule which shall take account, in particular, of the meteorological conditions which could be encountered on the site and proposed methods of progress measurement
- A personnel organization chart.

5.3.3 During operation

The Contractor shall maintain a chronological log of all major events occurring during operations. The documents presented to the Company's representative shall include daily reports, weekly or monthly progress reports, material sheets, inspection reports or test certificates and all routine documents.

The Contractor shall also provide the Company's representative with:

- The documents listed in **GS EP STR 431**
- The values measured to ensure that the installation tolerances have been met
- The weld inspection information.

In addition, the Contractor shall give the Company's representative prior notice of any major operations which he intends to undertake, and of any risk of an incident or accident which could occur during structure installation.

Finally, the Contractor shall provide the Company with written notice of final completion of installation.

5.3.4 After completion of installation

The Contractor shall supply the Company, within one month of completion of work, with a complete file comprising:

- As built drawings
- The complete installation report, which shall contain a clean and final version of all documents.

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6. Metocean

6.1 General

Weather restricted operation and weather un-restricted operations are defined per [ISO 19901-6](#) section 7.2.

Marine operations consists in two phases:

- Design and planning of the operation where
 - Metocean criteria** shall be developed to allow the design of relevant structures and installation aids.
 - Operability analysis** shall be performed to allow proper planning and selection of the installation spread based on the required weather window.
- Execution of the operation shall be based on the weather forecast, the Near Real Time (NRT) data (data with a time history 1-5 hours) and, if justified, on Real Time (RT) data (data with a time history 0-1 hours).

6.2 Metocean criteria

For weather restricted operations such as load-out, float-over, installations or generally lifting operations, operational limiting criteria will be developed as per section 6.2.3.

Transport longer than 48hours shall be weather non-restricted operations and metocean criteria developed as per section 6.2.1

Metocean criteria for mooring during weather restricted operations are detailed in section 6.2.2.

6.2.1 Transport

The design environmental conditions, which depend on the planned tow route, the transit duration and speed and the window departure, shall be provided by Company according to [GS EP GEO 504](#).

The transportation shall be designed to the 10 year monthly extremes for the planned transit period minus 1 month plus two months and for the worst route sectors, on the basis of a 30 day exposure, unless otherwise indicated in the Project Particular Specification (PPS).

Wave frequency tables shall be provided when a fatigue analysis during transportation is required (see sections 11.2.3.2, 11.2.4.5).

6.2.2 Mooring

Following [ISO 19901-7](#), design environmental conditions for a mooring system used for weather restricted operations shall be 10 year Return Period conditions however the configuration of the mooring during the weather restricted operation may have lower operability limits providing:

- Mooring operability limits are significantly higher that the limits of the operation itself (typically at least 20%)
- Time to reach the safe configuration (10 year Return Period Condition) is included in the analysis of the weather window duration.

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6.2.3 Weather window and operational limiting criteria

All requirements from [DNVGL-ST-N001](#) section 2.6 for defining weather window and operational limiting criteria shall be applied with the following additional considerations:

- Alpha factor is defined in the PPS
- Weather window duration equal or longer than 48h shall be defined and approved by Company prior contract award.

6.3 Operability analysis

For weather restricted operations, operability analysis shall be performed at basic stage for the preparation and the selection of the marine spread and installation aids, and during detail design stage by the selected contractor to prepare the planning.

Operability analysis have to be performed according to the principles detailed in [DNV-RP-H103](#).

6.4 Metocean monitoring during operation

The environmental data acquisition system on site shall be planned and defined in the PPS, typically it will include:

- A directional Datawell buoy installed upwards and close to the site
- A tide meter
- A current meter
- An anemometer

It can be practical to install the tide current and anemometer on a close existing platform it exists.

Objective of the monitoring is to calibrate forecasting models hence monitoring shall be installed sufficiently before the marine operations (typically at least 2 weeks before operation).

Weather monitoring at yard for load-out shall be defined with at minimum a wind measurement sensor and a tide sensor (both transmitting to the control room).

6.5 Weather forecast and routing

Weather forecast shall be planned and executed as per [GS EP GEO 506](#) on a 24-hour basis every:

- 12 hours, if the weather window duration is less than 12 hours
- 6 hours if the weather window duration is more than 12 hours.

Weather forecasts will start at least two weeks before the time of arrival at the installation site in order to allow for a calibration of the models.

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7. Company reserve and pre-service budget weight

7.1 General

Company Reserve definition and requirements are found in **GS EP STR 001** section 3.19.

Pre-service budget weight definition and requirements are found in **GS EP STR 001** section 3.20.

A Not To Exceed weight shall be defined by T&I Contractor for each pre-service phase and approved by Company at the beginning of detailed engineering phase. This information has to be clearly stated in the Weight Control Report, and updated at each WCR revision. Any modification of the NTE weight due to change of T&I procedure shall be approved by Company.

Weighing operation specification shall be included in the PPS.

7.2 Pre-service conditions

7.2.1 Loadout

The following items will be designed/checked for loadout conditions considering the object pre-service budget weight:

- Object to be loaded: primary and main bearing structure of the object (see section 10.2.1)
- Quay/foundations (see section 10.2.2.1)
- Skid ways, skid beams, skid shoes, link beams, barge grillage (see section 10.3.1)
- Push/pull system when applicable (see section 10.3.2)
- Trailers when applicable (see section 10.3.3)
- Barge (see section 10.4).

7.2.2 Transport

The following items will be designed/checked for transport conditions considering the object pre-service budget weight:

- Object to be transported: primary and main bearing structure of the object (see section 11.2.3)
- Seafastening and barge grillage (see section 11.2.4)
- Barge (see section 11.3).

7.2.3 Installation

The following items will be designed/checked for installation conditions considering the object pre-service budget weight:

- Object to be installed: primary and main bearing/lifting structure of the object
- Lifting ancillaries
- Crane

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- Substructures, guides and bumpers, etc.
- Barge.

8. Stability

8.1 Introduction

Sufficient stability and reserve buoyancy shall be ensured and documented for all vessels and floating objects in all stages of the marine operations. Stability requirements from [ISO 19901-6](#) shall be applied with the following requirements:

- During the basic design and during the bidding phase, for trans-oceanic and cyclonic area transportation no stability reduction based upon roll motions calculation is allowed by Company. It is meant that a minimum of 36 degree and 40 degree of intact stability range is required for respectively self-propelled vessels and cargo barges.
- Intact and damage stability have to be documented and submitted to Company, MWS and Third Party if any for review/approval.
- During the detailed design when the self-propelled vessel or the cargo barge is selected, if needed, consideration for reduction of the intact stability range based upon roll motions calculation can be submitted to Company and MWS for approval.
- For local tow, if needed, reduction of the intact stability range based upon roll motions calculation can be submitted to Company for approval.
- When motion analysis is required to satisfy the stability criteria, particular attention will be paid to the roll damping assessment to be addressed by model test if required and to be submitted to Company and MWS for approval.
- Metacentric height in any direction GM shall be above 1m considering free floating conditions.
- The free surface effect shall be minimized in ballast compartments.

8.2 Watertight integrity and temporary closures

Refer to [ISO 19901-6](#) section 9.11.

During load-out, whenever compartments access manholes would be obstructed by skid beams or grillage beams, these compartments shall be inspected and sealed before installation of beams, or temporary manholes shall be installed to allow for access.

Open manholes shall be surrounded by a coaming plate (6 mm thick, 200 mm high) and all other manholes shall be properly sealed when the free board is less than 1 m.

8.3 Weighing and inclining tests

If a weighing and inclining test are required as per [GS EP STR 001](#), classification or statutory requirements or any other reason, in addition to the recommendation of [ISO 19901-6](#) section 9.12, the following requirements shall be applied:

- Prediction of the lightweight, COG location and inclination are documented and approved by Company and relevant third party at least 24h prior performing inclining test.

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- Criteria in terms of accuracy of the prediction are developed, and inclining test is repeated once discrepancies between prediction and measurement have been solved if the accuracy criteria are not met.
- Draft and tank level readings methods as well as heel and trim measurements using a pendulum or an electronic inclinometer are calibrated, validated and approved by Company and MWS and classification society if relevant and heel and trim using a pendulum or an electronic inclinometer.

9. Ballasting

Refer to [ISO 19901-6](#) section 10 and [DNVGL-ST-N001](#) section 4.

9.1 Ballasting system

- The ballasting system shall be documented, as part of the ballast procedure, with:
 - Ballast manual of the barge when applicable
 - Arrangement drawings
 - Line diagram(s) for the ballast piping and/or distribution system
 - Line diagram(s) of the compressed air system when applicable
 - Line diagram(s) of the hydraulic system when applicable
 - Systems and equipment specifications, including as a minimum pumps, power source(s), sounding/gauging system.
- As far as possible, external pumps when used are connected to compartments by mean of steel pipes and manifolds.
- Sufficient spare hoses and spare parts have to be provided for the operation (loadout, floatover...).
- Ballasting using a compressed air system is not recommended and is subject to Company approval.

9.2 Ballast plan

Ballast plan shall:

- Include sufficient steps and be consistent with the steps of jacking, pulling or lifting as relevant
- Include sensitivity analysis with at least one step difference between load transfer and ballast for the most critical steps

9.3 Risk analysis

A FMEA study shall be implemented unless otherwise agreed with Company in the PPS to demonstrate that control of operations is not compromised by the failure of any single component, particularly where the component plays an important role in the performance of any stage of the operation.

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10. Loadout

10.1 General

Refer also to [DNVGL-ST-N001](#) section 10 and [ISO 19901-6](#) section 11.

10.1.1 Loadout methods

This section defines the conditions and methods which are required by Company for the loadout of heavy items including offshore jackets, modules, bridges and components from the shore onto floating or grounded barges.

Due to the wide range of objects, loadout methods and transport barges, this section cannot cover all aspects of every loadout scheme. Alternative proposals and methods will be considered on their own merits and can be approved if they are documented to be in accordance with safe practice.

Transshipment between two floating support is not allowed unless specifically approved by Company.

10.1.2 Applications

This section also applies to site moves. The object movement from the fabrication area to the quay side is considered as part of the loadout operation.

This section particularly applies to skidded and trailer-transported loadouts in tidal waters. Requirements for lifted and grounded loadouts are also included.

10.1.3 3D model and clash analysis

A 3D model of the loadout path up to the final position on the barge/vessel shall be built and dedicated review workshop planned and approved by Company and MWS.

Check of the compatibility between the loadout arrangement (skidways, skidshoes, skidbeams, etc.), the transportation arrangement (barge grillage, seafastening, etc.) and the installation requirements has to be specifically performed.

10.2 Structure, quay and soil

10.2.1 Structure to be loaded

The structure to be loaded, hereafter called the “object”, shall be designed to withstand the static and dynamic loads, support conditions (uneven support level for instance), environmental loads, uneven pulling/pushing loads and friction loads experienced during the loadout operation.

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10.2.1.1 Weight and centre of gravity

- The loadout analysis will be based on the best estimated object weight and centre of gravity, derived from the Weight Control Report. Final loadout analysis shall be assessed after object weighing.

The loadout analysis shall consider the following contingencies depending on the weight reference:

- The Pre-service Budget weight as defined in **GS EP STR 001** section 3.20, when applicable (i.e. for topsides).
- Same contingencies on the object weight as in the weight control report - which corresponds to the maximum expected weight - when the weight control report is the reference for the load cases.
- A global contingency that corresponds to the weighing accuracy, with a minimum of 3% - when the weighed weight is the reference for the load cases.
- The extremes of a CoG envelope centred on the calculated CoG, which corresponds to a rectangle whose sides are:
 - 5% of the overall width and length for a jacket, a flare, a vent boom or a bridge
 - 10% of the overall width and length, and not less than a 2 m x 2 m square for a deck.
- After weighing the extremes of a CoG envelope centred on the calculated CoG shall be ± 0.15 m in all horizontal directions unless otherwise specified by Company.

At the beginning of detailed engineering a COG envelop must be defined as explained above. During the development of the project, as long as the COG remains in the defined envelop with 0.15 m margin, no new calculation is required.

Whenever the results of a weighing (if any) would show a weighed weight greater than the maximum expected weight and/or an excessive CoG shift (as defined above), the loadout calculations will be revised to consider the weighed weight and CoG, and the structures shall be reinforced accordingly if required.

- The weighing of the object will be performed as specified in **GS EP STR 001** and/or as specified in the Project Particular Specification.

In case the weighing is performed with a jacking system, a contingency factor of not less than 1.10 will be conservatively applied to the weighed weight.

In case the weighing is not possible, the weight and centre of gravity of the object will be calculated with a great degree of accuracy prior to loadout and a contingency factor shall be conservatively applied to the calculated weight. This contingency factor, which depends on the accuracy of the Weight Control for all the loads (structural, equipment, etc.), shall not be less than 1.10, unless otherwise indicated in the Project Particular Specification.

- The loadout manual has to be updated after final object weighing, in particular to consolidate the ballast procedure.

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10.2.1.2 Design cases

- The loadout scenario has to be documented in detail and all specific loads generated in the object during loadout operation have to be identified. A calculation note shall be presented to Company and MWS to demonstrate the acceptability of these loads and any corresponding reinforcement required for the object.

A loadout operation does not represent one well defined load case, but a sequence of different load cases. The loadout operation has to be considered step-by-step and the most critical load cases for each specific element will be identified.

Intermediate stops or parking areas have to be considered and defined.

- When the loadout procedure is not known (at basic engineering stage for instance), the loadout analysis will be performed considering the two following cases:
 - Normal case: a vertical displacement of ± 30 mm is imposed to each object support point. These elementary support point deflections is then combined to cover any situation that can be met during loadout. The member stresses resulting from this analysis shall be compared to basic allowable stresses without the one third (1/3) increase even in case of loss of contact.
 - Extreme case: each object support is successively released (no support) or a maximum displacement of ± 60 mm is applied (three supports for a four point loadout arrangement and one row unsupported for a multipoint loadout arrangement). The member stresses resulting from this analysis shall be compared to the basic allowable stresses with the one third (1/3) increase.
 - The values of abrupt differences in the level of bearers during loading if design is not performed by Contractor shall be defined in the PPS
- For a skidded jacket, as extreme cases, the structure stresses shall be checked and compared to basic allowable stresses with the one third (1/3) increase, for the following conditions as a minimum:
 - The forward end of the jacket is cantilevered off the end of the fabrication yard skidways and the barge is ballasted to an elevation lower than required. The critical position is when the centre of gravity of the jacket is just at the end of the yard skidways.
 - The forward end of the jacket is resting on the barge but the centre of gravity of the jacket is still not on the barge skidbeams, and the barge is ballasted to an elevation higher than required. This will lift the jacket forward end until the jacket is supported at the extreme ends of the jacket leg launch runner.
 - The forward end of the jacket is moved onto the barge until the jacket centre of gravity is just on the barge skidbeams and the barge is ballasted to an elevation higher than required. The jacket tailing end would be cantilevered off the end of the barge.
- The skew loads due to misalignment between the barge and the quay skidways or uneven ballasting or uneven jacking/pulling/pushing loads has to be considered. The values to be used for support out-of-level will be indicated in the Project Particular Specification and subject to Company approval.

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Longitudinal and transversal stability of the object will be demonstrated with a minimum horizontal acceleration of 1 m/s^2 combined with the environmental loads and one damaged compartment.

For trailer and skidding loadouts, the reactions imposed onto the object by the trailer configuration have to be considered. The global stability shall be checked (bends, lateral loads, etc.)

- Stress levels shall be within those permitted by [API RP 2A-WSD](#). One third (1/3) increase for allowable stresses shall not be allowed for the normal case considering a minimum vertical displacement of $\pm 30 \text{ mm}$ between two adjacent supports. This value shall be documented by the Contractor taking into account the levelling control system and a reasonable achievable value. The details of the calculations shall be submitted to Company, MWS and Third Party if any for review/approval.
- Compatibility of support strength and elasticity against the support conditions used for analysis of the object shall be demonstrated.

Any intermediate supporting element between the object and the ground shall be checked according to above requirements, fabricated and inspected according to [GS EP STR 301](#) and classified in first category.

Consideration shall also be given to lifting off construction supports or onto seafastening supports when these operations form an integral part of the loadout operation taking into account re-distribution of forces and dynamic effects, sagging and hogging, tolerances, etc. during load transfer operations

10.2.1.3 Structural analysis report

Structural analysis report for the object to be loaded has to include:

- Structural drawings including any additional loadout steelwork
- Description of finite element program used
- Structural model
- Description of support conditions
- Load cases including derivation of weights and contingencies
- Unity checks
- Justification of overstressed members
- Detailed checks on object support points, padeyes, winch connection points and intermediate structures
- Proposals for reinforcements if required.

10.2.2 Quay and soil

10.2.2.1 Foundations

The adequacy of the quay, quay approaches, wall and foundations for the loadout shall be demonstrated and documented (including calculation notes), based on the proposed loadout

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scenario, the load distribution along the skidways and the vertical and horizontal peak loads at quay wall.

Compatibility between quay strength/elasticity and the support conditions used for the analysis of the object shall be demonstrated.

The capacity of all mooring bollards, winches and other attachments to be used shall be demonstrated and documented.

10.2.2.2 Seabed

Bathymetric information for area covered or crossed by the barge during loadout, post-loadout and sail way shall be supplied.

The seabed in front of the loadout quay shall be inspected for obstacles by divers or by an adequate survey method.

Underkeel clearance shall not be less than 1.0 meter during and after the loadout operation.

10.3 Systems and equipment

10.3.1 Skidways, skidbeams, skidshoes and link beams

10.3.1.1 Design of skidding equipment

- For each loadout scenario, loads to be experienced by the skidding equipment (skidways, skidbeams, skidshoes and link beams) shall be clearly identified and documented.

Adequate strength and stability of the skidding equipment and the load distribution in the object, the quay, the link beams, the barge and other loadout equipment, have to be demonstrated and documented considering all possible load combinations experienced during the loadout, such as - but not limited to:

- Differential settlement loads
- Uneven support level load
- Uneven horizontal push-pull load/effects of eccentricity of the push-pull loads
- Friction loads
- Wind loads
- Lateral loads
- Dynamic loads.

Longitudinal and transversal stability and integrity of the object to be loaded and the skidding equipment have to be demonstrated with a minimum horizontal acceleration of 1 m/s² combined with the environmental loads and one damaged compartment.

- Compatibility between strength and elasticity of the skidding equipment and the support conditions used for the loadout analysis of the object (see section 10.2.1) will be demonstrated. Local web stiffening of the skidding equipment have to be provided at the point loads to avoid any web buckling or crippling.
- Skidways shall be horizontal.

10.3.1.2 Link beams

In addition to the strength and stability requirements mentioned above, link beams shall be checked for loads induced by barge moorings, barge movements and pull/push on or pull/push back forces induced by loadout operation or emergency load off back to quay.

Tolerances on link beam movement have to be shown to be suitable for anticipated movements of the barge during the operation.

Alternative proposals and methods without link beams can be considered and can be approved if they are documented to comply with safe practice and all above requirements.

10.3.1.3 Sliding interface and friction coefficients

Particular attention has to be given to the design and fabrication of the sliding interface, which has to withstand the flatness defects of skid shoes and skid beams and their relative deformations.

Depending on the sliding surfaces, the following indicative coefficients of friction may be experienced during loadout. The loadout Contractor shall substantiate the choice of friction coefficient and lubrication used in the loadout calculations.

Level surfaces	Static			Moving		
	Min.	Typ.	Max.	Min.	Typ.	Max.
Sliding						
Steel/steel	0.15	0.20	0.35	0.10	0.15	0.25
Steel/grease/steel	0.10	0.15	0.30	0.08	0.12	0.20
Steel/Teflon	0.10	0.15	0.25	0.04	0.05	0.10
Stainless steel/Teflon	0.08	0.10	0.20	0.03	0.04	0.07
Teflon/grease/planed wood	0.08	0.14	0.25	0.03	0.06	0.08
Teflon/grease/wood	0.10	0.18	0.30	0.05	0.10	0.15
Steel/wood	0.20	0.40	0.60	0.15	0.30	0.40
Steel/grease/wood	0.15	0.30	0.40	0.10	0.15	0.20
Rubber tyres (locked)	0.20	0.35	0.50	-	-	-
Rolling						
Steel wheels/steel		0.01			0.01	
Rubber tyres/steel	0.01		0.02	0.01		0.02
Rubber tyres/gravel	0.02		0.06	0.02		0.04

10.3.1.4 Barge grillage and skidbeams

The grillage/skid beams on the barge shall be installed with the barge ballasted such that the deflected shape of the barge is the same as the static transportation condition (mimic condition).

The differential hogging or sagging of the barge due to different load/ballast arrangement at skid beams pre-installation stage shall be compensated by shimming.

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Longitudinal stability of the skidbeams on barge during the loadout operation has to be ensured by minimum welding. Final longitudinal welding of the skidbeam after the loadout operation has to be done when the barge is ballasted in the transport ballast configuration.

The area corresponding to the transport location shall be checked to ensure that the supports are at the nominal elevation with a tolerance of ± 5 mm. If not, shimming underneath the deck will be required after loadout before setting down of the object on its final transportation supports.

10.3.1.5 Inspection

Requirements defined in section 4.3 are applicable to all load-out equipments (skidway, link beams, skidshoes...).

10.3.2 Winches and jacking systems

10.3.2.1 General

Mixing systems with jacks and winches is prohibited: only one system has to be used for moving the object to the final position on the barge, except for the break-out (i.e. start-up) for which the assistance of additional pushing jacks is required.

The overall pushing jacks capacity shall be about 40% of the total required break-out load assuming a maximum static friction of 25% for a skidding operation.

A braking system capable of arresting object movement is required for all stages of the loadout.

The capacity of the winching or jacking system takes into account the slope, the sliding or rolling friction and losses in sheaves. Except for grounded loadouts, a barge inclination of 1.0% in addition to any planned inclination has to be accounted for.

The winching system, when used, has to be capable of moving the object from fully on the shore to fully on the barge without re-rigging.

The nominal calculated load on winching systems shall not exceed 80% of the certified Safe Working Load (SWL), unless full capacity test has been performed, after allowance for splices, bending, sheave losses, wear and corrosion and after taking into account the requirements of sections above. If no certified SWL is available, the nominal computed load shall not exceed a quarter (1/4) of the breaking load of any part of the system and a load test of the system shall be performed at $1.25 \times \text{SWL}$ or $0.33 \times \text{MBL}$ prior to the operation.

The complete winching system and any part thereof, including pulling eyes, tie bars and link-plates, multi-sheaves pulley blocks, shackles, pins, pulling wires, etc. shall be designed and justified for the full pulling capacity of the winch, even if the friction is anticipated to be much less than the full pulling capacity. In case any winching or jacking system is capable of exerting a greater force than the capacity of any other part of the pulling system, the winching system shall be fitted with a cut-out to prevent the system from SWL being exceeded, and the winch operator has to be clearly and formally instructed in not exceeding the SWL of the system.

10.3.2.2 Redundancy and back-up capacity

The winching or jacking system shall have a redundancy capacity such that the loadout can still proceed and be completed in the event of failure of any one mechanical component, hydraulic system, control system, power source.