



Exploration & Production

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 401

Installation of submarine pipelines

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Contents

1. Scope	5
2. Reference documents.....	5
3. Definitions and abbreviations	7
4. Safety and environment.....	7
4.1 Safety.....	7
4.2 Environment.....	7
4.3 Site reinstatement.....	7
5. Regulations.....	8
5.1 International Maritime Regulations	8
5.2 Local Authorities	8
6. Construction Engineering	8
6.1 General.....	8
6.2 Calculation notes	8
6.3 Procedures	9
6.4 Pipeline Characteristics Monitoring System	10
6.5 General laying procedure	11
6.6 Particular laying procedures	12
6.7 Contingency procedures.....	12
6.8 Anchoring procedures.....	13
6.9 Dynamic positioning procedures.....	14
6.10 Construction Manual.....	14
6.11 Mobilisation Manual.....	14
7. Installation spread and facilities	15
7.1 General.....	15
7.2 Diving spread.....	15
7.3 ROV spread	16
7.4 Station keeping and positioning system	16
7.5 Weather forecast and meteocean condition	17
8. Material.....	17



8.1	Care of material	17
8.2	Marking of materials	17
9.	Laying route preparation	17
9.1	Laying corridors	17
9.2	Pre-survey	18
9.3	Freespan assessment	18
9.4	Seabed preparation	19
9.5	Existing facilities	19
9.6	Shore Approaches	19
10.	Installation works	19
10.1	General	19
10.2	Laying direction	19
10.3	Pipeline standard assembly and laying	20
10.4	Connections	22
10.5	Freespan reduction	23
10.6	Corrosion protection	23
10.7	Offshore terminations	24
10.8	Onshore terminations	24
10.9	Crossings	26
10.10	Mechanical protection	26
10.11	Pipeline pre-commissioning	27
10.12	Scheduled stand-by and abandonment	27
10.13	Contingency	28
10.14	Final and contingency surveys	28
11.	Additional requirements for flexible pipe, cable and umbilical installation	29
11.1	General	29
11.2	Engineering	29
11.3	Pipe Characteristics Monitoring System	29
11.4	Laying equipment	30
11.5	Laying operation	30
11.6	Remedial works	31
11.7	Testing and Pre-commissioning of unbonded and bonded flexible pipe	31
11.8	Testing and Pre-commissioning of Umbilicals	32



12. Additional requirements for rigid pipe reeling installation.....	32
12.1 General.....	32
12.2 Laybarge requirements.....	32
12.3 Pipeline reeling qualification program.....	33
13. Scheduling.....	34
14. Completion file	35
15. Other references	35
Appendix 1 Shore Approaches	36



1. Scope

This specification - which shall be read in conjunction with the **GS EP PLR 100** - defines the minimum technical requirements with respect to the installation of submarine pipelines (S-Lay and J-Lay), flexible pipes, umbilicals, reeled pipes.

Pipeline installation in swamp areas, and towing out of bundles are not covered by the present General Specification.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
API SPEC 17J	Specification for unbonded flexible pipe
DNV-OS-F101	Offshore standard - Submarine Pipeline System
ISO 13628	Petroleum and Natural gas industries - Design and operation of Subsea Production Systems
ISO 13628-5	Petroleum and Natural gas industries - Design and operation of Subsea Production Systems - Part 5: Subsea umbilicals

Professional Documents

Reference	Title
API RP 17B	Recommended practice for flexible pipe

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	



Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP COR 201	Supply of sacrificial anodes
GS EP COR 420	External field joint coatings of pipelines
GS EP GEO 201	Offshore geophysical surveys
GS EP GEO 202	Geophysical Survey for the Installation and/or Inspection of Offshore Structures and Pipelines
GS EP LSO 410	Manned underwater operations
GS EP PLR 001	Documentation requirements
GS EP PLR 100	Submarine pipeline systems
GS EP PLR 109	Design, fabrication and testing of submarine unbonded flexible pipes and risers
GS EP PLR 110	Design, fabrication and testing of submarine bonded flexible pipes for deepwater terminals
GS EP PLR 160	Design, fabrication and testing of Subsea Umbilicals
GS EP PLR 403	Installation of onshore pipelines
GS EP PLR 404	Installation of steel pipeline by horizontal directional drilling
GS EP PLR 406	Storage and transportation of line pipes
GS EP PLR 410	Concrete coating for submarine pipelines
GS EP PLR 420	Site welding of carbon steel pipelines to API 1104 (sweet service)
GS EP PLR 421	Site welding of carbon steel pipelines to API 1104 (mild, intermediate and severe sour service)
GS EP PLR 501	Hydrostatic testing of pipelines
GS EP PLR 502	Precommissioning of gas pipelines
GS EP POS 001	Offshore surface positioning works
GS EP POS 002	Subsea positioning works
GS EP STR 402	Anchorage for support vessel on an offshore site



3. Definitions and abbreviations

The definitions stipulated in the **GS EP PLR 100** shall apply, but with the present General Specification, the following definition is modified:

Works Means the surveys, site preparation works, installation works, and reinstatement works, as a whole.

In addition, the following abbreviations are used in the present General Specification:

DP	Dynamic Positioning
ITA	Inline Tee Assembly
OBSROV	Observation ROV
OTDR	Optical Time Domain Reflectometry
PLET	Pipeline End Termination
ROT	Remote Operated Tool
ROV	Remote Operated Vehicle
TDP	Touch Down Point
TDR	Time Domain Reflectometry
WOROV	Work ROV

4. Safety and environment

4.1 Safety

At all times throughout the Works, all precautions necessary to actually prevent any accident in any location of his activities shall be taken and as a minimum, the Project Requirements shall be strictly fulfilled.

4.2 Environment

Special cares shall be taken on possible environment impacts.

A dedicated study shall be carried out to define the impacts of the proposed pipelines on the surroundings and in particular on the landfall, if applicable.

Contractor shall also evaluate and document any potential impacts of the construction works regarding noise, venting, sea current, possible spillage, disposals, smells, electrical/radio interference, positioning beacons, geodetic points, lights, etc., on the local populations and existing constructions, flora and fauna, shore profile, etc.

Local relevant Authorities or agencies will be listed and consulted as requested by the Project Requirements.

If deemed necessary, any alternatives consistent with the Project Requirements can be proposed.

4.3 Site reinstatement

At the completion of the pipeline installation, all non necessary installation aids shall have been removed before hydrostatic testing.



However, temporary positioning, protective and guiding devices shall not be retrieved until satisfactory completion of the installation and precommissioning works.

In addition, the Works shall culminate with the full reinstatement of the work sites as per above 4.2. Especially, all active subsea temporary components shall be removed.

5. Regulations

5.1 International Maritime Regulations

The Works shall be executed in compliance to the good practices edited by local and international Maritime Regulations.

5.2 Local Authorities

The Works shall be executed in full compliance with the acquired authorisations and permits from the local governing Authorities.

6. Construction Engineering

6.1 General

Contractor shall prepare - as necessary for the Project and according to the Reference Documents - the detailed engineering documentation which shall be permanently updated with due consideration of the most recent and accurate site and environmental design data as well as on the basis of the intended installation spread characteristics.

Special consideration shall be brought on the pipeline stress analysis, as outlined in further Section 6.4.

All of these documents shall have been approved by Company before the commencement of operations and/or mobilisation.

6.2 Calculation notes

The following calculation notes shall be prepared, as a minimum:

- Lay analysis
- Abandonment/Recovery of empty line
- Abandonment/Recovery of flooded line
- Maximum gouging length
- Maximum sea states during laying operations
- Pulling forces during shore approaches (if any)
- Sea bottom shifting analysis
- Fatigue analysis. Installation fatigue analysis shall take into account possibility of stand-by in addition to normal installation. Maximum allowable installation fatigue criteria shall be determined taking into consideration in-service fatigue life
- Evaluation of the residual stress, strain, out of roundness, out of straightness and metallurgical characteristics and evaluation on detail engineering results.



Calculations shall also be performed addressing installation of in-line structures (ITA, PLET, FLET and manifolds), including dynamic effects.

For pipe-in-pipe installation, calculations shall include detailed analysis of the field joint system during pipelay installation, interaction behaviour of inner and carrier pipes.

6.3 Procedures

The following procedures shall be prepared, as a minimum:

- Storage, handling, transportation and marking of the materials (Refer to Section 7.5 and Section 8.2)
- Laying route preparation, including prelay-surveys, freespan assessment, seabed preparation, existing facilities inventory, etc. (Refer to Section 9)
- Installation works as per section 10, including:
 - Station keeping and monitoring (Refer to Section 7.4)
 - Weather forecasting (Refer to Section 7.5)
 - Laying direction (Refer to Section 10.2)
 - Pipeline standard assembly and laying (Refer to Section 6.5 and Section 10.3)
 - Pipe inspection, internal cleaning, and repairs (Refer to Sections 10.3.2 to 10.3.4)
 - Detection of buckles, associated contingency and repair methods (Refer to Section 6.7, Section 10.3.7 and Section 10.12)
 - Surface and subsea connections diver assisted or diverless, mechanical or hyperbaric welding (Refer to Section 10.4)
 - Freespan reduction works (Refer to Section 10.5)
 - Corrosion protection of field joint (Refer to Section 10.6)
 - Special procedures (Refer to Section 6.6)
 - Contingency Plan (Refer to Section 6.7 and Section 10.12)
 - Offshore terminations, including subsea and surface works, installation of risers and appurtenances, etc., and intermediate subsea tie-ins (Refer to Section 10.7)
 - Onshore terminations, including onshore preparation works, pipeline pulling, etc. (Refer to Section 10.8)
 - Crossings (Refer to Section 10.9)
 - Mechanical protection such as trenching, backfilling, covering, etc. (Refer to Section 10.10)
 - For pipe-in-pipe installation, procedures shall include field joint assembly and coating and, as appropriate, anode installation
 - ITA and PLET and buckle arrestors installation.
- Pipeline hydrotesting and pre-commissioning (Refer to Section 10.11)
- Final and contingency surveys (Refer to Section 10.12)
- Site reinstatement works (Refer to Section 4.3).

6.4 Pipeline Characteristics Monitoring System

The detailed global and local stress and strain analysis results shall serve to set up an operational schedule of the monitored lay-barge parameters and this schedule shall be as simple as possible in order to reflect immediately any likely or confirmed shift of the monitored data towards unsafe areas.

In the view of the installation works, a dedicated pipelaying software package - as far as possible the same as the one permanently allocated for the selected laying vessel - shall be provided onboard the laying vessel.

The operational schedule and the monitoring system shall be fully described in the Construction Manual and referred as "The Pipeline Characteristics Monitoring System", aim of which being to ensure that normal and contingency installation works are conducted in a safe manner given the parameters of the Project.

More precisely, this system shall be designed so as to provide instantaneous direct or indirect access to pipeline buckling and collapse safety margin, pipeline as-laid versus initial routing gap, static and dynamic deflections, fatigue, etc.

The schedule of laying parameters shall reflect four distinct areas, which shall consist of:

- A first area, inside which laying operation can be normally conducted (safe area) or resumed (if interrupted)
- A second area, inside which the normal laying operation shall be stopped
- A third area, inside which the pipeline shall be abandoned
- A fourth area, inside which damage of pipeline is confirmed or highly suspected.

As a minimum, the following parameters shall be recorded in a continuous way and made available to Company, with calibration against allowable areas defined above, for:

- Pipe tension, tensioning devices setting and dead band
- Cumulated fatigue loading
- Out of roundness and straightness (in case of plastic deformation)
- Water depth
- Continuous view (video) of the last itemised roller where the pipe is resting on before going off the stinger
- Pipe departure angle
- J-Lay tower angle
- Continuous monitoring (OBSROV) at TDP
- Horizontal distance from pipe departure at the vessel to TDP
- Loads at the pipeline supports
- Tension in the buckle detector wire (S-lay)
- Barge / vessel motions (roll, pitch, sway, heave)
- Barge / vessel draft and trim



- Current velocity and direction at or near the location of the laybarge
- Significant wave height, period and direction
- Wind speed and direction
- Co-ordinates of the following locations:
 - The barge ramp rollers relative to the deck level and the stern of the barge
 - The stinger hitch relative to the deck level and the stern of the barge
 - The stinger rollers relative to the stinger hitch and the axes of the stinger.

The calculation shall be prepared by Company recognised software as per **GS EP PLR 001** requirements.

Any shutdown (installation equipment, monitoring equipment or other), shall be reported.

6.5 General laying procedure

This procedure (S-lay, J-lay) shall describe the different operations necessary for assembling the pipelines (single jointing or double jointing or more) and refer to detailed procedures for each specific operations and in particular:

- Inspection and possible repair of pipe coatings
- Bevelling
- Lining-up
- Welding
- Inspections and possible welding repairs
- Field joint coatings
- Tagging, marking, numbering.

This procedure shall demonstrate that the pipelines configuration (e.g. geometry of welding ramp-stinger-unsupported pipeline section) is such as to keep the pipeline stresses within allowable values as per the Stress Monitoring System principles and requirements (Refer to Section 6.5).

The lay-barge mooring / DP system shall be assessed with regard to the various morphological and bathymetric conditions and the necessary tension for safe pipe laying.

For a mooring system, the assessment shall include in particular:

- Tension in mooring lines and general anchor pattern
- Anchor types
- Sequence of anchor relocation and mooring in congested problem areas
- Barge position and heading



- Lay-barge maximum movement as a function of bow and stern mooring lines characteristics
- Horizontal translation and lay-barge correct alignment in relation to laying route axis in case of dynamic forces acting against the unsupported pipeline section and on the same lay-barge (tri-dimensional mathematical model).

For a DP system, the assessment shall include in particular:

- Vessel bollard pull
- Barge position and heading
- Lay-barge maximum movement as a function of DP accuracy
- Horizontal translation and lay-barge correct alignment in relation to laying route axis in case of dynamic forces acting against the unsupported pipeline section and on the same lay-barge (tri-dimensional mathematical model).

6.6 Particular laying procedures

In the case of uneven situations which may occur in the course of normal laying phases, dedicated procedures shall be developed, with due consideration on the necessitated techniques and equipment.

For these cases, offshore control system of pipeline touchdown point on the bottom shall be available, in order to carry out laying operations complying with the final conditions (target areas, tolerances for pipeline location) provided for in the design.

If the situation is not perceived in advance, new procedures shall be developed and/or designed and approved, aiming at reducing the induced loss of time.

Special laying procedures shall address initiation, laydown, pipeline crossings, installation of tee, sled in line, piggy back lines, and shall refer to the standard laying procedure.

The procedure shall therefore describe:

- Method of high accuracy lay barge positioning
- Underwater inspection immediately preceding pipe laying
- Underwater inspection to constantly check the pipeline at the touchdown point
- The variation of pipeline tension simultaneously with lay-barge lateral displacement
- Anchor pattern and mooring lines tension.

6.7 Contingency procedures

Procedures describing in detail which action is to be taken in the event of major equipment failures, adverse weather, sea conditions and accidents shall be prepared.

Topics, which specifically need to be addressed, are:

- Mooring system / DP system
- Tensioning system
- Abandonment/recovery system