

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 401

Installation of submarine pipelines
--

14	12/2019	General review
13	11/2017	General review
12	05/2015	Organisation change - January 2015
11	10/2014	General review
10	10/2013	General Specifications references update
00	02/2001	First issue
Rev.	Date	Purpose of the revision

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

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 2 of 132

Contents

1. Scope	6
2. Reference documents.....	6
3. Definitions of terms	11
4. Safety and environment	14
4.1 Safety	14
4.2 Environment	15
4.3 Health	15
5. Installation engineering design premises.....	16
5.1 Pipeline installation design limits.....	16
5.2 Route curve stability	17
6. Construction & Installation Engineering.....	18
6.1 General.....	18
6.2 Calculation notes and analyses	19
6.3 Procedures	21
6.4 Installation Monitoring System	23
6.5 General pipelay procedure.....	26
6.6 Specific installation procedures.....	27
6.7 Contingency procedures	28
6.8 Anchoring mooring procedures	29
6.9 Dynamic positioning system and procedures	32
6.10 Construction Manual.....	32
6.11 Mobilisation Manual	33
6.12 Documents Control	34
7. Installation spread, equipment, facilities and other means	34
7.1 General.....	34
7.2 Technical Assurance Qualification Program – TAQP	37
7.3 Installation / construction equipment and other means.....	43
7.4 Diving spread.....	55
7.5 ROV spread.....	55

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 3 of 132

7.6	Positioning system	56
7.7	Deck area	57
7.8	Handling loads	58
7.9	Weather forecast and metocean conditions	59
7.10	DP system	60
7.11	Anchor mooring	60
7.12	Video monitoring equipment	61
7.13	Personnel	62
7.14	Final acceptance.....	62
8.	Logistic	63
8.1	General.....	63
8.2	Marking of materials	64
9.	Laying route and installation tolerances	65
9.1	Laying route and required lengths.....	65
9.2	Installation tolerances	65
9.3	Pre-lay freespan considerations.....	68
9.4	Seabed preparation	69
9.5	Existing facilities	69
10.	Installation/construction works.....	70
10.1	General.....	70
10.2	Laying direction and installation sequence.....	71
10.3	Pipeline system construction and installation	71
10.4	Initiation, Laydown and A&R	78
10.5	Tie-in means	81
10.6	Freespans.....	85
10.7	Risers	86
10.8	Rigid spools and jumpers.....	89
10.9	Onshore termination – Landfall / Shore approach	90
10.10	Crossings and supports.....	95
10.11	Piggyback installation.....	97
10.12	Wire rope based installation	100
10.13	Pipeline / Product protection and post lay interventions.....	101

Installation of submarine pipelines

Rev.: 14

Effective date: 12/2019

Page: 4 of 132

10.14	Pipeline system pre-commissioning	108
10.15	Contingency	109
10.16	Survey	109
10.17	Inline Structures	112
10.18	Buckle Arrestors	117
10.19	Safe handling and exclusion zones	117
10.20	Access to Sites	118
11.	Additional requirements for Products	118
11.1	General	118
11.2	Laying equipment and installation means	118
11.3	Installation engineering	119
11.4	Installation activities considerations	120
11.5	Testing and pre-commissioning of flexible pipes	120
11.6	Testing and pre-commissioning of umbilicals	121
12.	Additional requirements for PIP	121
12.1	General	121
12.2	PIP steel bulkheads	122
12.3	PIP centralizers	123
13.	Additional requirements for Reel-lay	124
13.1	General	124
13.2	Reel lay equipment	124
13.3	Installation engineering	125
13.4	Pipe straightening considerations	125
13.5	Pipe rotation considerations	126
13.6	Pipeline reeling qualification program	127
13.7	Pipeline thermal performance considerations	128
13.8	Reeled PIP assembly	128
14.	Scheduling	128
15.	Reporting	130
15.1	Daily Progress Report	130
15.2	Installation Task Completion Report	130
15.3	Bridge, Construction, ROV and diving logs	131



General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 5 of 132

16. Operation completion report 132

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 6 of 132

1. Scope

This General Specification defines the Company requirements and recommendations with respect to the installation and construction of submarine/offshore:

- Pipeline systems (by S-Lay, J-Lay, Reel-Lay, towing and/or other laying techniques) including all related sub-systems and components;
- Pipe bundle systems (by towing and/or other laying techniques) including all related sub-systems and components;
- Products including all related sub-systems and components;
- Inline Structures;
- Risers;
- Spools/jumpers;
- Tie-ins;
- I-tubes, J-tubes;
- Pipeline/Products protections, supports and other;
- other related sub-systems and components.

2. Reference documents

The reference External Documents and Company General Specifications listed in this section form an integral part of this General Specification.

This specification shall be read in conjunction with the **GS EP PLR 100**.

The Works shall be executed in compliance with Project Particular Specifications, Company General Specifications (see § 2), applicable international standards (see § 2), applicable local and international maritime regulations and acquired authorizations / permits from the local governing authorities.

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 17B	Recommended Practice for Flexible Pipe
API SPEC 17J	Specification for Unbonded Flexible Pipe
API SPEC 17K	Specification for Bonded Flexible Pipe

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 7 of 132

Reference	Title
BV Rule №526	Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units
DNVGL-OS-E301	Position mooring
DNVGL-OS-E303	Offshore fibre ropes
DNVGL-OS-E304	Offshore mooring steel wire ropes
DNVGL-RP-F107	Risk assessment of pipeline protection
DNVGL-RP-F114	Pipe-soil interaction for submarine pipelines
DNVGL-RP-N101	Risk management in marine and subsea operations
DNVGL-RP-N103	Modelling and analysis of marine operations
DNVGL-RP-N201	Lifting appliances used in subsea operations
DNVGL-RP-0232	Pipeline and cable laying equipment
DNVGL-ST-E407	Rope based deployment and recovery systems for designated service
DNVGL-ST-F101	Submarine Pipeline Systems
DNVGL-ST-F201	Dynamic risers
DNVGL-ST-N001	Marine operations and marine warranty
DNVGL-ST-0378	Standard for offshore and platform lifting appliances
IMCA M 194	Guidance on wire rope integrity management for vessels in the offshore industry
IMCA D042 (IMCA LR003, IMCA R016)	Diver and ROV based concrete mattress handling, deployment, installation, repositioning and decommissioning
ISO 13628 (Parts 5; 8)	Petroleum and natural gas industries - Design and operation of subsea production systems - Parts 5; 8

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 8 of 132

Reference	Title
ISO 19901-7	Petroleum and natural gas industries - Specific requirements for offshore structures - Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units
ISO 10425	Steel wire ropes for the petroleum and natural gas industries - Minimum requirements and terms of acceptance
ISO 4309	Cranes - Wire ropes - Care and maintenance, inspection and discard

Company 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 201	Galvanic anodes according to EN 12496
GS EP COR 401	Installation of anodes on submerged pipelines
GS EP COR 420	External field joint coatings of pipelines
GS EP ENV 001	Environmental requirements for projects design and E&P activities
GS EP ENV 011	Environmental specification for onshore pipeline construction
GS EP ENV 111	Environmental Baseline and Monitoring Studies: Onshore Sites
GS EP ENV 112	Environmental Baseline and Monitoring Studies in Offshore and Coastal Waters
GS EP EXP 311	Plant Integrity – Minimum Inspection Requirements
GS EP GEO 201	Offshore Geophysical Site Investigation
GS EP GEO 202	ROV Survey Work for the Installation and/or the Inspection of Offshore Structures and Flowlines
GS EP GEO 207	ROV Seabed Survey
GS EP GEO 506	Meteorological and Oceanographic Forecasting

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 9 of 132

Reference	Title
GS EP GEO 701	Geotechnical Design Considerations for Soil-Pipeline Interaction
GS EP GEO 702	Requirements for Design and Installation of Skirted Foundations and Suction Anchors
GS EP GEO 703	Requirements for design and installation of drag anchors and anchor piles for offshore floating structures
GS EP LSO 201	Towing and Anchor Handling Operations
GS EP LSO 202	Personnel Transfer between Watercrafts and between Watercrafts and Offshore Structures
GS EP LSO 207	Notices to mariners and restricted navigation zone
GS EP LSO 306	Selection and Operation of Dynamically Positioned Vessels
GS EP LSO 410	Manned Underwater Operations
GS EP PLR 001	Documentation requirements
GS EP PLR 100	Submarine pipeline systems
GS EP PLR 104	Onshore 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
GS EP PLR 151	Design of steel catenary riser systems
GS EP PLR 152	Hybrid Riser Systems
GS EP PLR 160	Design, fabrication and testing of Subsea Umbilicals
GS EP PLR 403	Installation of onshore pipelines
GS EP PLR 406	Storage, handling and transportation of pipes
GS EP PLR 410	Concrete coating for pipelines

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 10 of 132

Reference	Title
GS EP PLR 425	Site welding of carbon steel pipelines (sweet and sour service, onshore and offshore) according to API STD 1104
GS EP PLR 426	Site welding of carbon steel and CRA pipelines (sweet and sour service, onshore and offshore) according to DNVGL-ST-F101
GS EP PLR 430	Automated Ultrasonic Testing of pipeline girth welds according to DNVGL standards
GS EP PLR 431	Real time radiography inspection
GS EP PLR 501	Hydrostatic testing of pipelines
GS EP PLR 502	Pre-commissioning of pipelines
GS EP POS 001	Offshore surface positioning works
GS EP POS 002	Subsea positioning works
GS EP POS 004	The use of Differential Global Navigation Satellite System
GS EP SAF 041	Technological risk assessment methodology
GS EP SAF 221	Safety rules for buildings
GS EP SPS 007	Subsea Connection Systems
GS EP SPS 027	WROV spread minimum requirements
GS EP SPS 030	Observation ROV spread minimum requirements
GS EP SPS 033	Subsea Intervention Tooling
GS EP SPS 038	Subsea Structures design & fabrication
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 401	Loadout, seafastening, transportation and installation of offshore structures

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 11 of 132

Reference	Title
GS EP STR 402	Anchorage for a 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 901	Design rules and construction standards for ancillary structures of offshore installations

3. Definitions of terms

In the present General Specification, the definitions stipulated in the **GS EP PLR 100** shall apply in addition to the following:

Company	Total E&P
Congested area	A congested area represents such a section along the route (of a pipeline system or Product) with restricted access due to close proximity of existing subsea equipment, pipelines, structures and other facilities; like platform / FPSO / FSO approach, riser bases, wells location, tie-in locations, etc.
Installation Spread	See § 7.1 for the specification and definition of the Installation Spread used during the Works related to installation / construction of pipelines, Products and other permanent or temporary items.
Inline Structure	Means pipeline structural component that is integrated part of the pipeline and connected or welded to the pipeline during laying like ITA, PLET, FLET, SSIV and similar subsea structures. Typically, this structure are made of piping components, connectors, skid/frames, valves, actuators, tee, wye, mudmat and other.
pipeline	Means a submarine line extending between one single entry point and one single delivery point; so that any other connected line shall be treated as another individual pipeline.
Permanent Item	Means a pipeline/Product components, risers, spools, jumpers, subsea structures, Inline Structures, support, protection means and other items approved by Company and permanently installed (during duration of related pipeline/Product service life and beyond).
Product(s)	Means items (including all related components) specified as flexible pipes, umbilicals and cables.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 12 of 132

Third Party	Means a Certifying Authority, or a Classification Authority, or an independent Company in charge of any independent design review, appraisal, or analysis.
Work(s)	Could mean any work(s) related to the installation and construction of the pipeline systems, Products and other like: survey works; at the site preparatory works; seabed preparatory works; positioning works; transportation; storage; handling; lifting; pipeline/Product shore approach works; onshore required works; pipeline assembly; pipeline reeling/unreeling; pipeline/Product initiation, laying, laydown and A&R; pipelines, risers, rigid spools/jumpers and Inline Structures construction & installation; pipeline / Product / riser towing activities; Installation Spread (including related equipment and other means) mobilisation and demobilisation; pipeline and Product pre-commissioning works; spools and jumpers installation; tie-in works; inspection, test, calibration, and certification works; protection works; sites reinstatement works and other

In the present General Specification, the abbreviations stipulated in the **GS EP PLR 100** are used in addition to the following:

AHC	Active Heave Compensation
API	American Petroleum Institute
A&R	Abandonment and Recovery
BM	Buoyancy Module
CB	Cargo Barge
CoB	Centre of Buoyancy
CoG	Centre of Gravity
DP	Dynamic Positioning
FAT	Fabrication Acceptance Test
FJC	Field Joint Coating
FLET	Flowline End Termination
FPSO	Floating Production Storage and Offloading vessel
FSO	Floating Storage and Offloading vessel

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 13 of 132

HQ	Head-Quarter
IMCA	International Marine Contractors Association
IMR	Inspection-Maintenance and Repair
ITA	Inline Tee Assembly
LBL	Long Baseline Acoustic Positioning System
lux	A unit of illumination as per the International System of Units
MAL	Maximum Accidental Loads
MBL	Minimum Breaking Load
MDL	Maximum Dynamic Loads
metocean	Meteorology and Oceanography
MPI	Magnetic Particle Inspection
NDT/NDE	Non Destructive Testing/Examination
PLET/PLEM	Pipeline End Termination/Manifold
PPS	Project Particular Specification
ROT	Remote Operated Tool
ROV	Remote Operated Vehicle
SSIV	Subsea Insulation Valve
SWL	Safe Working Load
TAQP	Technical assurance Qualification Program
TDP	Touch Down Point
TMS	Tug Management System
T&I	Transportation and Installation
TOP	Top of Pipe

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 14 of 132

4. Safety and environment

Any potential or present impact of the Works on the:

- safety and health of local populations, working personnel/staff and other people that might be impacted by the Works;
- environment (like shore profile disturbance, noise disturbance, gas venting, sea pollution/disturbance, possible spillage, air pollution, disposals, smells, electrical/radio interference, positioning beacons signals, geodetic points, lights, working sites and other);
- existing facilities, structures, services, asset and other;
- flora and fauna;
- and other,

shall be evaluated, documented and immediately reported to Company.

4.1 Safety

At all times throughout the life of the Project and during execution of the Work, risk management including methodology and risk assessments shall be performed in compliance with Contractors and Company requirements including [GS EP SAF 041](#) and [DNVGL-RP-N101](#).

Specific job risk assessments (or equivalent) shall be performed to cover all working activities (operations, tasks, steps and other) related to execution and completion of the Works related to installation and construction.

Before beginning of the working activities at the site (yard, Installation Spread, topside, vessel, barge, etc.), findings of the risk assessments for working activities (operations, tasks, steps and other) shall be reviewed and verified by the key construction / installation personnel involved in the Works (like supervisors, team leaders, vessel masters, construction managers, etc.) and Company Representatives by taking into consideration at the site present conditions.

A working activity (operations, tasks, steps and other) shall commence only after confirmation that the risk level is considered acceptable for the work-related activity, after implementation of all identified mitigations and after full familiarization of the personnel (directly involved in the work) with the work-related activity.

Facilities including accommodation on the Main and Assistance Installation Spread (any type of vessel, barge, fixed or floating structure) involved in the execution of the Works shall be compliant with rules specified for offshore buildings as per [GS EP SAF 221](#) (Section 6. Human comfort and health; Section 9. Catering; Section 10. Waste disposal).

During the Work, personnel shall not use stacked/stored pipes or other stored items as a working surface, access corridors, walking surfaces or similar.

On-board any Installation or Supply spread (or similar), specific fall personal protective equipment (like harness, lanyards, fall arrestors, shock absorbers) shall be used for works

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 15 of 132

performed on any elevated surface (like deck gallery, platform, step, structure or similar) that is above the deck floor and is not secured with collective fall protection systems (like guardrails, handrails, safety nets, cages, etc.).

4.2 Environment

All the Works related to the installation and construction shall be performed in compliance with **GS EP ENV 001**, **GS EP ENV 011**, **GS EP ENV 111** and **GS EP ENV 112**.

For the execution and completion of the Works, as minimum, shall be prepared an environment management plan, waste management plan and environmental studies to assess impacts/ concerns (air pollution, noise, water pollution, soils, land erosion prevention, reinstatement and other) of the Works on the surroundings.

4.2.1 Site reinstatement

All temporary/non-permanent equipment, devices and other items shall be designed and installed in such a way so that their entire removal after completion of Works is feasible in a safe way for permanent items.

At the completion of the pipeline/Product system installation, all temporary/non-permanent equipment, devices and other items attached to the pipeline/Product system shall be removed before final hydrostatic (strength and/or leak) testing of the system.

Unless otherwise instructed by Company, temporary positioning, protective and guiding devices shall be maintained in place until satisfactory completion of the installation, pre-commissioning and hydrostatic-tests related works.

The Works shall culminate with the full reinstatement of the work sites and removal of all temporary/non-permanent items from the site.

4.3 Health

To perform their duties, all offshore personnel involved in execution and completion of the Works shall be healthy, physically and mentally fit.

All personnel shall hold valid medical certificates attesting that they are medically fit to perform the duties they are to carry out at their working place.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 16 of 132

5. Installation engineering design premises

5.1 Pipeline installation design limits

A single design criteria and/or combination of design criteria applied for rigid steel pipeline installation/construction design engineering related works shall be:

- Compliant with [DNVGL-ST-F101](#) and with criteria specified in this section;
- Submitted to Company for approval prior to commencement of the related installation/construction design engineering works.

For the evaluation of the rigid steel pipeline integrity during installation/construction, a combination of different design criteria (stress or strain based criteria) could be implemented along the pipeline catenary (displacement or load controlled pipeline sections), under condition that along a single specific pipeline section it shall be implemented only one selected criteria.

In case selected the stress based (load controlled) criteria for a specific pipeline catenary section, the maximum static Von Mises (combined) stress on the pipe during installation/construction shall not exceed 72% of SMYS.

In case selected the stress based (load controlled) criteria for a specific pipeline catenary section, the pipe integrity under dynamic effects/loads during installation/construction shall be verified through the load controlled local buckling checks as per [DNVGL-ST-F101](#) (Section 5).

In case selected the strain based criteria for the displacement controlled section of the pipeline catenary, the maximum allowable pipe static strain during installation/construction shall not exceed:

- 0.25% for the steel grade X65 and X70 (as per API standard grade);
- 0.23% for the steel grades X60 and X56 (as per API standard grade);
- 0.205% for steel grades X52 and grades below up to X42 (as per API standard grade).

In case selected the strain based criteria for the displacement controlled section of the pipeline catenary, the maximum allowable pipe dynamic strain during installation/construction shall be:

- Limited to 0.35%;
- Verified through the displacement controlled local buckling checks as per [DNVGL-ST-F101](#) (Section 5).

For the stress based (load controlled) criteria/verifications of installation analyses (including calculations, checks and similar) it shall be applied linear steel material properties.

For the strained based (displacement controlled) criteria/verifications of installation analyses (including calculations, checks and similar) it shall be applied non-linear steel material properties.

The impacts/effects of the line pipes transportation, sea freight, handling, coating and other pre-construction or pre-installation activities on the overall pipeline design fatigue life shall be

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 17 of 132

evaluated and considered for the pipeline design but not less than 3% of the overall pipeline design fatigue life.

At least 10% of the overall pipeline design fatigue life or more following the results of the related fatigue analysis shall be considered for the pipeline construction / installation.

At least 10% of the overall pipeline design fatigue life or more following the results of the related fatigue analysis shall be considered in total for the pipeline as-laid activities like tie-in, remediation/corrections activities, pre-commissioning, pressure testing (strength and/or leak tests), de-watering and commissioning.

Pipe fatigue consumption during pipes transportation/handling, construction, installation and as-laid activities shall be evaluated, recorded and considered in the overall distribution of the design fatigue life.

All effects of the installation/construction related works on the installed (as-laid) pipeline like residual stresses, residual strains, residual tensions and similar that impact pipeline conditions/behaviours during service life shall be assessed, recorded and considered in the pipeline design.

For the stress based (load controlled) criteria/verifications, the maximum Von Mises (combined) stress on the pipe for installation/construction of the pipeline system under dynamic effects, in flooded condition, accidental flooding cases and other extreme/accidental conditions shall not exceed 96% of SMYS.

The dynamic pipe laying analysis shall be performed by considering the sea-state duration of minimum 3 hours.

The calculated strain and stresses shall include all applicable effects of bending, axial loads, variation of stiffness (due to different material properties at transition locations, coating properties, field joints, buckle arrestors and similar), local point loads (at the contact with tensioner, clamps, pipe supporting elements, etc.), interaction with the seabed at the TDP and other.

The pipeline integrity (including all applicable calculated pipeline stresses, bending moments, tensions, strains and other) for installation/construction shall be verified through the load controlled and displacement controlled local buckling checks as per [DNVGL-ST-F101](#) (Section 5) and where applicable (like for cases governed by tension beyond applicability of [DNVGL-ST-F101](#)) as per [DNVGL-ST-F201](#) (Section 5).

The pipeline concrete coating integrity shall be verified as per [DNVGL-ST-F101](#) (Section 13.7.2).

5.2 Route curve stability

The theoretical pipe / Product route curve stability shall be verified in order to confirm that the curve radius along the route is stable during installation under the maximum dynamic residual bottom tension and minimum evaluated value for the soil friction factor.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 18 of 132

At least a safety factor of 1.15 shall be used for the verification of the route curve stability during installation.

6. Construction & Installation Engineering

6.1 General

All the Works related to the installation / construction including engineering of the pipeline system, Product and other related permanent items shall:

- Ensure integrity, safety working load limitations and safety margins for the pipeline system (including its components), Products and other permanent items (like subsea structures, manifolds, components of the subsea production systems and other) and facilities (like topsides and other);
- Comply with this specification, applicable Project Particular Specifications, Company General Specification (see § 2) including [GS EP PLR 001](#), [GS EP PLR 100](#), [GS EP PLR 109](#), [GS EP PLR 110](#), [GS EP PLR 151](#), [GS EP PLR 152](#), [GS EP PLR 160](#), [GS EP SPS 038](#), [GS EP STR 401](#), [API RP 17B](#), [DNVGL-ST-F101](#), [DNVGL-ST-N001](#) and [ISO 13628-5](#).

Unless otherwise instructed by the Company, all technical documentation (like analyses, studies, reports, calculation notes, procedures, installation/construction/fabrication manuals, layouts, drawings and other) prepared for the Works shall be:

- Submitted for Company review and approval prior to be used for the Works;
- Available at the related sites (in hard paper copies and in soft copies on an external hard drive device or equivalent non-volatile memory hardware device that permanently stores and retrieves data) after Company approval for construction/installation.

The Works shall be performed in compliance with Company approved technical documentation updated with due consideration of the most recent and accurate data related to pipeline / Product systems, permanent items, environmental conditions, at the site conditions, Installation Spread and equipment, existing pipeline / Product / structures / facilities and other.

The full compliance of the Works in respect to the Company approved documentation shall be checked by Company Representatives (onboard an Installation Spread, at yards, at a spool base, on fixed or floating offshore structures and other working sites) during the execution and completion of the Works.

All installation/construction procedures, activities, operations, steps, sequences, tasks and other similar working processes related to the Work shall be designed/engineered as reversible.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 19 of 132

6.2 Calculation notes and analyses

Where applicable, but not limited to, the following calculations and analyses shall be prepared for the Works related to installation/ construction of pipelines, Products and other related permanent items:

1. Laying installation analyses for pipeline system and Product by considering static, functional, dynamic, environmental, accidental and other at site conditions or effects:
 - Initiation analyses,
 - Normal lay analyses,
 - Transition analyses for laying of different pipeline or Product properties (change in OD, WT, steel grade, coating thickness, etc.),
 - Laydown / termination analyses,
 - A&R analyses considering empty and flooded pipeline system or Product,
 - Inline Structure (or similar) installation analyses,
 - Dynamic analyses for assessment of maximum allowable environmental and at the site conditions including construction spread (with related equipment) operational limitations and motions;
2. Lateral lay curve stability analyses during installation;
3. Stacking or storage analyses for pipes, Products and other items;
4. Load out and packing (reels, carousels, etc.) analyses;
5. Weld repair analyses (maximum repair gouging length and depth) for rigid pipes;
6. Pipeline/Products installation fatigue analysis to take into account possibility of stand-by, slow-lay or other interruptions in addition to normal lay installation. Maximum allowable installation fatigue criteria to be determined taking into consideration:
 - Pipeline or Product systems in-service fatigue life,
 - Pipeline or Product base material and/or components properties,
 - Weld properties and quality,
 - Loads based on variation of stiffness, supports properties, seabed properties, motions induced by at the site conditions, Installation Spread (including equipment) characteristics, etc;
7. Fatigue analysis by taking into consideration pipes transportation, sea freight, handling, coating and other pre- construction or pre-installation activities;
8. Fatigue analysis by taking into consideration pipeline as-laid activities like tie-in, remediation/corrections activities, pre-commissioning, pressure testing (strength and/or leak tests), de-watering and commissioning;
9. Pipes reeling / unreeling analysis including related out-of-straightness, out-of-roundness (ovality), fatigue and hold back tension verifications;
10. Pipeline/Products landfall / Shore approach analysis including pulling forces calculation and on-bottom stability during operation;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 20 of 132

11. Towing analyses (bottom tow, off-bottom, controlled depth tow, surface tow, etc.);
12. Tie in analyses (spool/jumper tie-in, above water tie in, etc.);
13. Hydrodynamic, stability and transportation analyses for the Installation Spread including the Supply Spread (cargo barges, transportation / supply vessels, cargo vessels, etc.);
14. Deck layout arrangement and strength analyses;
15. Seafastening analyses;
16. Lifting and deployment analyses / calculations;
17. Integrity verification and dimensioning analyses of equipment, tools, rigging, lifting beams/frames, installation aids, pipe heads and similar;
18. Clearance verifications for transfer of Inline Structures, pipe heads, installation aids and other components through production mainline/firelines, working stations, moonpool, over the stinger and similar;
19. Integrity analyses (global and local compression) at Product or pipeline system (including all components line pipes, tubes, cables, FJC, anodes, Inline Structures, etc.) contact or connection points with installation equipment (tensioner, hang-off clamp / module, straightener, reel, etc.), supporting elements (like chutes, deflectors, pads, rollers, supports, etc.), deck, rigging, installation aids, soil and similar;
20. Integrity analyses (global and local including interaction behaviour) between components of piggyback and carrying lines, pipe-in-pipe components and bundle system components;
21. Evaluation of the installation/construction residual stress, strain, out of roundness, out of straightness and other changes in pipes metallurgical characteristics including their impact on detail engineering results;
22. Time estimate analysis for the completion of the Works including related activities (operations, installation steps, tasks, processes) and other working processes;
23. In addition, other specific to the planned activities during the Works.

Calculations and analyses shall be performed to ensure that the integrity of pipelines, Products and other permanent and temporary items is satisfied, as per Company approved designed criteria and/or parameters, for each task to be performed during execution of the Works.

All computer software models (including related input data) used the installation analyses shall be validated by Company or the Third Party nominated by the Company prior to be used for the Works (engineering, analyses, studies and other).

All computer software models (including related input data) used for installation analyses shall perfectly match properties of the analyzed/related pipelines, Products, permanent or temporary items, Installation Spread, equipment and other applicable means, environmental conditions, a site conditions and other.

Results of the pipeline/Product laying analyses shall:

- Ensure that pipeline/Product designed integrity criteria are satisfied for the designed limiting environmental conditions (specified for the operations) and applied loads of equipment (that is acting on the pipe);

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 21 of 132

- Be summarized in lay tables and provided in relevant procedures;
- Cover every change or modification of any parameter that is impacting operations like tensioner set-up, A&R winch set-up, pipe/Product storage equipment set-up, pipe/Product departure angle, elevation/inclination of pipeline termination, stinger angle, tower angle, Installation Spread position/heading, supports configuration, hang off points elevations and other.

6.3 Procedures

Where applicable, but not limited to, procedures for the Works (including method statements/philosophies) shall specify, detail, cover and/or address following subjects:

1. Installation methodology including description of the activities in work / task plans, lift plans, detailed step-by-step sequences and similar;
2. Permanent items to be installed including related design premises and design criteria;
3. Installation criteria and parameters including related limitations, tolerances, safety margins, clearances, etc;
4. Environmental and at site limitations for all activities related to the Works (like lifting, laying, towing, load-out, deck handling, welding / NDT, tie-in, transporting, positioning, CB / vessel mooring, ROV, diving, anchor handling, trenching, etc.);
5. Installation parameters monitoring and control system;
6. Equipment and tool settings to ensure monitoring and control of approved installation parameters;
7. Characteristics of the Installation Spread including all installation equipment, installation aids, tools, rigging and similar;
8. Organisation including personnel roles, responsibilities and communication principles;
9. HSE and security requirements including risk assessment findings, permit to work system description, emergency response requirements, safety working or exclusion zones, etc;
10. Simultaneous operations and co-activities - especially for the Works inside the fields under production/operation;
11. QA / QC requirements;
12. Management of change and non-conformity systems;
13. Expected at site conditions including metocean and soil data;
14. High accuracy positioning and survey system requirements;
15. Initial status at the site;
16. Route preparations and minimum required lay radius/curves;
17. Inspection and test requirements including reporting forms and check lists;
18. Analysis/calculation results including laying tables;
19. Required interface works with existing facilities (if any) and protections of existing facilities. Safe handling zones and access/entry and exit corridors for Installation Spread during the Works (lifting, overboarding, deployment and other);

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 22 of 132

20. Related drawings, layouts, alignment sheets, lifting drawing / sketches, activities story board for step by step sequences, sketches and similar.

Where applicable, but not limited to, following procedures shall be prepared for the Works:

1. Storage, stacking, packing, handling, transportation and marking of the materials (see § 8);
2. Preparatory works at the site like laying route preparation, pre-lay-surveys, free-span seabed interventions, seabed preparations, existing facilities inventory, etc. (see § 9 and § 10);
3. Installation / construction related works specified in this document and in particular:
 - Pipeline general construction (see § 6.5 and § 10.3),
 - Specific Procedures (see § 6.6),
 - Contingency and repairs (see § 6.7 and § 10),
 - Station keeping (see § 6.8 and § 6.9) and positioning (see § 7.6),
 - Weather forecasting metocean condition management (see § 7.9),
 - Laying direction (see § 10.2),
 - Detection of buckle or damage (see § 10),
 - Linepipe inspection, tagging / marking, internal cleaning, gauging and repairs (see § 10.3),
 - Tie-in means (see § 10.5),
 - Free-span reduction works (see § 10.6),
 - Corrosion protection of field joint (see § 10.3.7),
 - Installation of risers (§ 10.7),
 - Spools and jumpers installation (§ 10.8),
 - Pipeline/Product subsea terminations, offshore terminations and appurtenances,
 - Pipeline/Product onshore terminations, landfall / shore approach including all onshore preparation works, pipeline pulling, etc. (see § 10.9),
 - Crossings (see § 10.10),
 - Piggy back installation (see § 10.11)
 - Protection for pipeline or Product (see § 10.13),
 - Inline Structures installation (see § 10.17),
 - Pipeline components installation including forged Tee or Wye, anodes, valves, terminations, buckle arrestors, water stops, etc.
 - Product installation including load-out, spooling/unspooling, testing, etc. (see § 11),
 - Pipeline reeling and unreeling (see § 12),
 - Pipeline onshore or offshore stalks fabrication,

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 23 of 132

- Installation of sleepers, supports, buckling mitigations, etc.
 - Installation of the initiation anchoring points and rigging,
 - Towing (bottom tow, off-bottom, controlled depth tow and surface tow, etc.) procedure including launching, tow, approach and final positioning,
 - Other pipeline/Product installation or construction related activities;
4. Pipeline hydrostatic testing (strength tests, leak tests and other) and pre-commissioning (see § 10.14);
 5. Pipeline/Product protection works (see §10.13) and other post laid activities;
 6. Final and contingency surveys (see § 10.16);
 7. Scheduling (see § 14);
 8. Site reinstatement works (see § 4.2.1).

If conditions at the site during execution and completion of the Works are not compliant with the Company approved documents or not perceived in advance, the following activities/steps shall be taken and carried out:

- Step 1: The related works to be stopped,
- Step 2: All affected documents (analyses, procedures, task plans and other) to be reviewed and modified where applicable,
- Step 3: If required, new documents to be developed for the works to close any identified gaps,
- Step 4: Dedicated risk assessments to be performed prior to restart of the works.

Prior to start / re-start of the Works the dedicated risks assessment shall be performed and required identified mitigations put in place.

In the procedures, principles and requirements regarding the management and monitoring of the installation/construction parameters during the Works shall comply with § 6.4

6.4 Installation Monitoring System

The installation monitoring system, shall be developed based on following, but not limited to:

- Company approved installation/construction parameters and engineering documentation (analyses, calculations, procedures, drawings and other) including results and recommendations;
- Safety working load limitations and safety margins for the pipeline system (including its components), Products and other permanent items (like spools, jumpers, subsea structures, manifolds, components of the subsea production systems and other) and facilities (like topsides and other);
- Safe working load limitations and margins of the Installation Spread, equipment, installation aids, tools, materials and other means;
- Designed limiting environmental conditions;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 24 of 132

- Minimum required installation clearances and tolerances;
- Safety clearances, handling zones, exclusion zones and other safety requirements, including risk assessments findings and mitigations.

The installation monitoring system shall reflect following four distinct areas during the Works:

1. "The first area" – This area is the safe working area inside which installation operations can be normally conducted or resumed (if interrupted).
2. "The second area" – This area is the limiting safe area. In this area : Pipelines, Products, permanent and temporary items integrity during works is still within the allowable limits but with very low safety margins; Works are stopped if it is expected further deterioration of the at the working conditions/factors/parameters that could lead to non-safe conditions; Required abandonment operations of pipelines, Products and other items is completed prior to deterioration of the working conditions/factors/parameters that could lead to non-safe conditions.
3. "The third area" – This area is non-safe area. In this are pipeline, Product, permanent and temporary items integrity during works is compromised (no safety margin). Pipelines, Products and other items are abandoned, stored and secured in the safe condition.
4. "The fourth area" – This area is accidental/damage area inside which damage of Pipelines, Products and other items is highly suspected and confirmed.

The installation monitoring system shall be:

- Compliant with Company requirements and approved documentation;
- Developed for the continuous control, monitoring and recording of the applicable installation/construction parameters during the Works;
- Developed to provide instantaneous access and correlation between the real-time monitored installation/construction parameters and designed safety limitations/ criteria/ tolerances/clearances and margins;
- Developed to immediately detect any shift of the real-time monitored installation/construction parameters outside the safe area as defined above in the point I - "The first area".
- Implemented on board Installation Spread and at working sites (yards, spool bases and other) during mobilisation and prior to the start of the installation/ construction Works;
- As simple as possible and fully described in the approved procedures (or manuals) with the aim to ensure that the Works are conducted in a safe manner by ensuring integrity of pipeline, Products, permanent items, Installation Spread including equipment and personnel.

A dedicated Company approved computer software package, the same one used in the office for the analyses/ calculations related to the Work, shall be provided onboard the Main and Assistance Installation Spread for the verification of the installation / construction parameters during the Works.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 25 of 132

Direct reading and processing of continuously monitored and recorded installation / construction parameters from all required essential instrumentation, measuring devices, video monitoring system and similar shall be ensured at the site (Installation Spread, spool base, yards, shore approach site, etc.) and made available to Company.

Any lack of certification, malfunction or failure of the equipment, instruments, devices, video system or similar used for processing, monitoring or recording of the construction / installation parameters during the Works shall be immediately reported to Company and corrected.

As a minimum, but not limited to, the following installation / construction parameters shall be continuously monitored, continuously recorded and made available to Company, with the calibration against "The first area" (defined above in the point I):

1. Pipeline or Product top tension;
2. Tensioner device tensioning settings including dead band, squeeze pressure and pay out/in speed;
3. Mechanized pipelay clamps (like hang off clamps / modules, travelling clamp, etc.) squeeze pressure, loads and coordinates;
4. A&R winch cable tension, speed and pay out/in length;
5. Cumulated fatigue loading based on fatigue analysis results;
6. Pipeline or Product supports / rollers / roller-boxes (on construction spread, in spool bases, in yards, on quaysides, etc.) configuration and loads;
7. Pipeline or Product departure angle from the Installation Spread;
8. Continuous monitoring with ROV or equivalent at TDP for verification of pipeline/Product:
 - Layback distances (horizontal distance from a reference point on the Installation Spread to TDP),
 - Integrity status including: all related components, Inline Structure, anodes, coating, field joints, terminations, piggy backs, position over crossings / sleepers including required safety clearances and other.
9. Pipelines/Products installation coordinates, headings, routings, laid curves, target boxes, clearances with seabed, clearances with existing structures (permanent or temporary), etc.
10. Vertical lay (J-Lay, Reel-Lay, Flex / umbilical lay, etc.) towers: angle, rollers coordinates and loads;
11. Stinger: angle, ballast plan, pipe support coordinates and loads and loads in a mechanical supporting / attaching system;
12. Continuous view of the pipeline / Product subsea supporting elements (like stinger rollers, vertical lay tower roller boxes, etc.);
13. Out of roundness and straightness for Reel lay;
14. Pipeline or Products hold-back tension on the reel (reeling / unreeling);
15. Load on the aligner during Reel-lay;
16. Davit or similar line: tension, angle, pay out/in speed and length;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 26 of 132

17. Cranes parameters;
18. Any pipeline lifting / pulling device line: tension, speed and pay out/in length;
19. Continuous monitoring of Inline Structure position, rotation and heading during installation;
20. Continuous monitoring of piggy back / bundle position, rotation and heading during installation;
21. Loads in equipment used for handling of pipe, Inline Structures, Products, etc.
22. Tension in the buckle detector wire for S-lay;
23. Tension and/or torque values for bolting;
24. Main Installation Spread and Installation Assistance Spread: position and heading, motions (roll, pitch, yaw, sway, heave, surge), draft and trim;
25. Installation Spread DP system parameters;
26. Installation Spread anchor mooring system parameters. For the each mooring line system to be provided: anchor location, tension, heading, speed and pay out/in lengths;
27. Environmental conditions like water depth, sea current (velocity and direction), significant wave (height period and direction), wind (speed and direction).

6.5 General pipelay procedure

Where applicable, but not limited to, general pipelay procedures (including method statements/philosophies) shall specify, detail, cover and/or address all activities necessary for the installation and construction / assembly of the pipeline system, in particular:

1. Pipes / materials transfer onboard, handling, load out, lifting, spooling, reeling, packing, storage, etc.;
2. Pipes inspection, cleaning, gauging and possible repair of pipe coating system;
3. Pipes bevelling, pre-heating and other preparatory works for pipes welding/tie-in;
4. Insertion of pipes into production process, fireline, lay tower including pipe line-up;
5. Pipes welding process;
6. Inspections including NDT/NDE of welds and possible welding repairs;
7. Field joint coatings including repairs;
8. Anodes installation (if done offshore during laying);
9. Pipeline initiation including preparatory works;
10. All activities related to Normal pipelay in S-lay, J-lay and Reel-lay including installation parameters monitoring;
11. Pipeline laydown or termination;
12. Tagging, marking, numbering;
13. Applicable risk assessment findings.

In particular, the general procedure shall:

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 27 of 132

- Ensure that the Works are done in safe working conditions for all equipment and personnel/crew;
- Ensure pipeline integrity by keeping the pipeline installation parameters including pipeline configuration in the safe condition during installation and within the allowable safety limitations and margins;
- Efficient correlation with related specific and contingency procedures for each activity which is not covered by the general procedure.

6.6 Specific installation procedures

Dedicated specific installation procedures shall be developed in case of situations and requirements that may occur in the course of general activities.

The specific installation procedures shall consider following, but not limited to:

- Complex initiations and laydown of pipelines/ Products;
- Pipelines/Products installation over crossings, sleepers and other supports;
- Installation of crossings, sleepers and other supports;
- Installation of Inline Structures;
- Installation of simple inline forged Tee/ Wye components, dummy spools and similar during pipelay;
- Installation of pipeline/Product system components;
- Installation of piggy back lines;
- Reeling and spooling;
- Towing;
- Tie-ins installation;
- Spools / jumpers installation;
- Risers installation;
- Load-out of Products;
- Products installation;
- Buoyancy modules (temporary and permanent) installation and recovery;
- Shore approach installation;
- Pre-commissioning and hydro-testing;
- Trenching, dredging and backfilling;
- Rock dumping;
- Freespan corrections;
- Seabed pre-lay or post-lay interventions;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 28 of 132

- Pipeline/Product protection installation;
- Survey, positioning and metrology;
- Pipes/Products handling, storage and transportation;
- Lift plans;
- And any other activity required for the Works that are not covered by the general procedures (see § 6.3).

6.7 Contingency procedures

Contingency procedures shall describe detail actions to be taken in the case of non-desired, non-planned and/or not engineered events like: failure / breakdown of Installation Spread and/or equipment, changed at site conditions, deterioration of the environmental conditions at the site (like increased seastate, wind and other), various accidents / incidents and other.

In particular, but not limited to, the following considerations shall be addressed in the contingency procedures:

- Pipeline system or Product damage, buckling, denting, coating damage, anode damage and similar failures during the Work;
- Positioning and station keeping systems (mooring system / DP system) failure;
- Tensioning and/or load control systems (like tensioner, A&R, winch, cranes, travelling blocks, hang off modules / clamps, etc.) failure;
- A&R system in case of emergency (increased weather, storm, change of at site conditions, etc.) or/and pipe damage (dry or flooded pipeline).
- Installation equipment (stinger, vertical lay towers, pipe erectors, rollers / supports, cranes, reels, carousels, chutes, straighteners, etc.) failure;
- Installation aids, tools and rigging failure;
- Assessment of suspected damage on pipeline and/or Product systems including related components; Accurate identification and positioning of the pipe damage and as-left / as-laid pipeline system; Detailed reporting system on incidental/accidental events;
- Repair/removal of proven damages on pipelines and/or Product system with related components, including;
- Exceed of engineered installation fatigue damage limits. Assessment of fatigue consumed during stand-by (due to mechanical breakdown, weld repair / cut-out, increased seastate conditions, logistic issues, incidents, accidents, etc.) and mitigations applied. Recording of consumed fatigue;
- Pipeline or Product installed outside crossing / support / sleeper approved tolerances. Missed crossing / support / sleeper;
- Pipeline or Product laid curve pulled-out during laying;
- Missed installation tolerances like target box, heading, tilt, inclination, clearances and other;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 29 of 132

- Loss of pipeline / Product system buoyancy capacity during installation including loss of buoyancy modules;
- Loss of hold back tension during initiation;
- Adverted weather/ sea-state conditions during Pipeline or Product installation;
- Rotation / damage of the Inline Structures and piggy back line.

Contingency procedures for the pipeline buckle case during installation shall reflect the following three typical scenarios:

- Dry buckle - damaged section of the pipeline can be recovered during installation on the Installation Spread deck for a repair;
- Dry buckle - damaged section of the pipeline cannot be recovered during installation on the Installation Spread deck for a repair;
- Wet buckle - pipe flooding.

6.8 Anchoring mooring procedures

An anchor mooring system activities and engineering (analyses, procedures, patterns, drawings, etc.) shall be in compliance with [ISO 19901-7](#), [DNVGL-OS-E301](#), [DNVGL-ST-N001](#), [DNVGL-ST-F101](#), [GS EP GEO 703](#), [GS EP POS 001](#), [GS EP STR 402](#) and [GS EP STR 004](#).

During installation of the pipelines or Products, the Main Installation Spread shall be moored with minimum 8 (eight) anchor mooring lines.

For each mooring task to be performed, static and dynamic mooring analyses shall be performed to determine mooring system installation parameters and limitations in terms of designed environmental conditions (including seabed soil properties).

The mooring analyses shall include as minimum following cases:

- Intact mooring lines conditions;
- Single mooring line failure condition;
- Redundancy condition (transition between the intact and the single mooring line failure).

The anchor mooring station keeping systems shall be assessed and designed with regard to the expected installation/ construction loads (static, dynamic and accidental) and with regard the expected at the site designed environmental conditions characterized by parameters with a return period of at least 10 years.

The anchoring mooring system failure during pipeline/Products installation shall be considered as a failure that may well lead to unacceptable consequences such as loss of life, collision with an adjacent platform or vessel, uncontrolled outflow of oil or gas, vessel capsize or sinking, damage to the pipeline/Product system or existing structures.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 30 of 132

Minimum clearances between the anchor mooring lines and existing pipelines/Products, for the designed environmental conditions, shall be:

- 10m of vertical clearance for the intact conditions;
- 3m of vertical clearance for accidental case conditions (like the failure of one mooring line);
- 100m of horizontal clearance between the mooring line touchdown point and pipelines/Products for intact conditions and 50m for accidental case conditions (like the failure of one mooring line).

Minimum horizontal clearances between the anchor mooring lines and existing subsea structures (like wellheads, manifolds, FLET, ITA and other), for the designed environmental conditions, shall be 150m for the intact mooring conditions and 50m for accidental case conditions (like the failure of one mooring line).

Minimum horizontal clearances between the anchor mooring lines and existing risers, for the designed environmental conditions, shall be 100m for the intact mooring conditions and 30m for the accidental case conditions (like the failure of one mooring line).

A mooring line shall not cross any riser or subsea structure (like wellheads, manifolds, FLET, ITA and other).

Minimum required anchors exclusion zone (no anchors installed inside this zone) shall be:

- within 200m area of an existing pipeline/Product;
- for a mooring line crossing an existing pipeline/Product within 400m area of crossing between the mooring line and the pipeline/Product;
- within 300m area around an existing subsea structure.

During transit or movement of an anchor handling tug for installation/repositioning of an anchor or during any mooring line handling operations, especially inside Company specified anchor exclusion zones (including crossing above any existing subsea pipeline, Products, structures, facility and similar), the anchor shall be secured on the deck of the anchor handling tug (or similar) and not suspended over the stern or side of the tug.

Target area for anchors installation shall not exceed 15 m radius.

Anchor mooring lines during mooring activities shall not be dragged across any seabed sensitive areas, geohazards, debris, structures, services, facilities, irregularities or similar that may compromise integrity of the mooring line or the item/subject in the contact with the mooring line.

Prior installation / construction related works a dedicated anchor corridor surveys shall be performed to locate all existing pipelines/Products, facilities, subsea structures, seabed debris / irregularities and similar (see § 10.16.2).

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 31 of 132

All findings of the anchor corridor surveys shall be:

- Analysed and recorded in the anchor patterns and survey system / charts,
- Shown on the survey / navigation system (displayed on the survey / navigation screens) on-board Installation Spread (like pipelay vessel/barge) during the Works,
- Used for reference when installing/handling anchors and mooring lines especially near the existing pipelines/Products, subsea sensitive areas, geohazards, structures, debris, irregularities, facilities and other.

Detailed description for the proposed anchor mooring system including anchor patterns and other drawings shall be supplied in the procedure.

Anchor patterns showing the position of the moored Installation Spread including mooring lines, anchors and attached buoyancy modules shall be updated through the whole duration of the Works and made available onboard the spread.

During installation and mooring works, onboard an Installation Spread, dedicated anchor patterns shall be:

- continuously generated on-line with sufficient provision (personnel, equipment software, hardware and other) provided onboard the Installation Spread for this activities;
- integrated and continuously updated in the survey / navigation system and displayed on the survey / navigation screens;
- used for the monitoring of the installation and mooring parameters including required safety clearances, tolerances and limitations.

In anchor mooring procedures following, but not limited to, shall be detailed:

- Mooring system detailed specification and limitations;
- Anchors – type and properties;
- Steel wires – type and properties (diameter, lengths, weights, MBL etc.);
- Pennant buoys – type and properties (dimensions, floating capacity, weight, etc.);
- Anchor line midline buoys – type and properties (dimensions, floating capacity, weight, etc.);
- Rigging – type and properties (dimensions, weights, SWL);
- Anchor positions;
- Mooring lines heading, tensions and lengths for anchor patterns by considering designed environmental conditions at the site;
- A sequence of anchor pattern set-up (for start-up, congested areas and demobilization) including anchors relocation;
- The moored Installation Spread position, heading and movements (taking into consideration mooring lines characteristics);
- Position of midline buoyancy tanks along anchor lines;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 32 of 132

- Accidental cases (a single line failure applied for each line) and redundancy check;
- The lateral translation and the Installation Spread correct alignment in relation to the laying route axis in case of dynamic forces acting against the pipeline / Product (tri-dimensional model).

6.9 Dynamic positioning system and procedures

An Installation Spread using a dynamic positioning system shall comply with [DNVGL-ST-F101](#), [DNVGL-ST-N001](#), [GS EP POS 001](#), [GS EP POS 004](#) and [GS EP LSO 306](#).

All components of the DP system (including thrusters and their ancillary parts, a power supply, distribution systems, and position references) shall be fit for purpose, 100% operational and with all redundancy available during the Works.

An assessment of DP system safe working limits in terms of expected at site metocean conditions and installation/ construction loads during the Works shall be assessed and known by considering in particular:

- The bollard pull capacity;
- DP capability analysis vs. horizontal pipeline/ Product installation load components in case of static, dynamic and contingency/accidental cases;
- Installation Spread position, motions and heading;
- Installation Spread maximum movement as a function of DP accuracy;
- DP accidental cases (worst case single point failure in the propulsion or DP system);
- The lateral translation and the Installation Spread correct alignment in relation to the laying route axis in case of dynamic forces acting against the pipeline / Product (tri-dimensional model).

6.10 Construction Manual

The engineering documents necessary for the execution and completion of the Works shall be gathered in a construction manual (or similar) and delivered to Company for review and approval prior to be used for the Works.

The construction manuals shall contain following, but not limited to:

- The detail technical documentation (procedures, analysis reports, calculation notes, drawings, layouts, and other related documentation) applicable for the execution of the Works as specified in this document;
- The installation monitoring system description, as per § 6.4;
- Designed allowable environmental condition at the site including required contingencies and installation weather windows to complete the Works;
- HSE and Emergency response plans;
- Quality assurance and quality control plans;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 33 of 132

- Definition of all safe handling zones, safe exclusion zones, safety clearances and tolerances for the installation/construction works;
- Risk assessments including related mitigation measures;
- Simultaneous operations and co-activities dossiers;
- Management of change procedure;
- Non conformity procedure;
- Schedule.

6.11 Mobilisation Manual

An Installation Spread shall be mobilized in compliance with Company approved a mobilisation manual.

The mobilisation manuals shall include following, but not limited to:

- Mobilisation procedure;
- Mobilisation schedule;
- The detailed list of mobilized equipment, installation aids, tools, permanent and temporary items, materials, consumables, etc., including specifications, calibration certificates, test reports, IMR procedures, spare parts and other;
- Installation Spread deck layout with indicated mobilised equipment, installation aids, consumables, permanent items and other;
- Layouts and maps of quaysides, yards, jetty, ports and similar;
- Sea-fastening (calculations and drawings);
- TAQP dossier including Compliance report (see § 7.2);
- Inspection and Test plans;
- Maintenance plans;
- Verification of required software (used for laying analyses and other) integrated onboard the Installation Spread.

The Installation Spread and its equipment and other means including personnel/crew shall be considered as mobilised only after successful completion of related TAQP (see § 7.2).

During mobilisation, if so requested, Company Representatives shall be given the free access to all Installation Spread, facilities, equipment, items, parts (assembled or dismantled) and other means used for the Works.

If facilities, equipment, items, materials and parts related to the Works are not in an acceptable condition, the necessary repairs, corrections, replacements, new calibrations and tests shall be carried before completion of the mobilisation.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 34 of 132

6.12 Documents Control

All documentation developed for the Works like analyses, calculations, drawings, plans, manuals, procedures (marine, construction, installation, contingency, standard operating procedures, etc.) or similar shall be submitted to Company for review and approval before being implemented and used for the Works.

After Company approval, any changes related to the design and engineering of the pipeline system, Products, permanent or other items related to the Works shall be fully documented and where applicable all impacted documents shall be corrected and re-submitted to Company for review and approval before being implemented and used for the Works.

Only documentation in the “Approved for Construction” status (or equivalent approved status) by Company shall be used for the Works.

Contractors (including its subcontractors) internal documentation like standard operating procedures, job safety analyses, standard practices, working policy, guidelines and similar shall be used for the Works only after Company review and approval.

7. Installation spread, equipment, facilities and other means

7.1 General

An Installation Spread comprises, but not limited to, the following equipment and other means including personnel/crew, required for the Works:

1. The Main Installation Spread: vessels and barges for construction / installation / laying of pipeline / Product systems (like S-lay, J-lay, Reel-lay and Flex-lay vessels), that are equipped with all necessitated equipment and facilities including mooring or/and DP system, laying system, assembly (welding, NDT/NDE, FJC, etc.) equipment, cranes, pipe / structures handling equipment, storage equipment, diving spread, ROV spread, survey spread and other;
2. The Assistance Installation Spread: assistance vessels and barges (like light construction vessel, dive support vessels, subsea construction vessels and similar) and their equipment (including mooring or/and DP system, cranes, diving spread, ROV spread, survey spread, etc.) as necessary for limited construction / installation works and/or IMR works and/or subsea intervention works and/or survey works and/or other similar works;
3. The Support Spread: support vessels and their equipment as necessary for survey works and/or towing and/or station keeping and/or anchor handling and similar;
4. The Supply Spread: supply vessels and barges for the transportation of pipes, Products, permanent components / structures, installation aids, equipment, materials and other items required for the Works;
5. The Dredging Spread: barges and vessels including equipment for pipeline / Product systems related trenching, dredging, backfilling, excavation works, seabed preparation and similar;
6. The onshore equipment and other means involved in the pipeline system or Product construction / installation related activities, such as cranes, transporters, landfall / shore

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 35 of 132

approach pulling equipment, reels, storage equipment, tensioners, supporting elements and similar;

- The equipment and other means on the existing offshore facility (like platform, FPSO, FSO and other) involved in the pipeline system or Product constriction / installation related activities (pull in/out, hook up, tie-in and other).

An Installation Spread and its equipment as well as any other facility, means, equipment, tool, installation aids, temporary structures, lifting gear, rigging and other items used for the Works shall be:

- In compliance with this specification, applicable Project Particular Specifications, Company General Specifications listed in § 2 and in particular with **GS EP STR 401** and **GS EP EXP 311**;
- In compliance with requirements and recommendations of suppliers of the equipment and recommendations;
- In compliance with External documents listed in § 2 and in particular with **DNVGL-ST-F101**, **DNVGL-ST-N001**, **DNVGL-ST-E407**, **DNVGL-RP-N103**, **DNVGL-RP-N201**, **DNVGL-RP-0232**, **DNVGL-ST-0378**;
- In fit for purpose condition, in serviceable condition and ready to perform the Work in a safe way, with no lost time and with full spread operability throughout the duration of Works as per Company requirements;
- Suited to handle the pipeline system or Product in a safe way for personnel and equipment within the designed working load limitations and by taking into account static loads, dynamic loads, accidental loads and the site conditions during execution of Works;
- Inspected, calibrated, tested and certified minimum once per year (every 12 months);
- Continuously maintained with minimum required spares (as per Company or Suppliers recommendations) available at the site in order to ensure execution and completion of the Works within the time frame as indicated on the Project approved schedule;
- Equipped with required certified sensors, load gauges and instruments allowing continuous monitoring and recording of the parameters specified in § 6.4;
- Equipped with camera(s) to enable visual monitoring of the pipeline or Product status during installation activities covering the complete pipeline or Products storage areas, routing, production process, lay equipment, deployment and over-boarding sections including subsea components (like stinger tip rollers or lay tower subsea roller boxes);
- Rated with SWL limitations that are greater or equal to the maximum expected loads (including the worst accidental case like flooded pipeline system under dynamic conditions) during execution of Works.

During the Works, if so requested, Company Representatives shall be given the free access to all Installation Spreads, facilities, equipment, items, parts (assembled or dismantled) and other means mobilised for the Works.

If during the Works, an inspection reveals that the mobilised Installation Spread, facilities, equipment, tool and other means used for the Works are not in the acceptable condition (faulty,

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 36 of 132

damaged, non-adequately maintained, with expired certificates, de-rated, non-compliant with Company requirements or similar) the following activities/steps shall be taken:

- Step 1: All related/impacted working activities in progress to be stopped;
- Step 2: All necessary repairs, corrections, replacements and similar activities to be carried out to bring the Installation Spread, facilities, equipment, tool and other means in the acceptable condition;
- Step 3: Prior to start/re-start of the working activities, new dedicated inspections and tests of the Installation Spread, facilities, equipment, tool and other means to be carried out.

Tests, inspections and calibrations not witnessed by Company Representative or Company nominated Third Party representative shall be considered as non-valid.

Equipment including any other means maintenance, calibration, testing or certification that would required stopping of the Works shall not be planned after completion of the related mobilisation and during the whole duration of the installation/ construction Works and until the completion of the demobilisation.

Maintenance logs shall be up to date with:

- Inspection, maintenance and repair works done;
- Planned inspection and maintenance program;
- Spare part status.

During the Works onboard the Installation Spread or other facility (like spool base, load out yard or similar), a short-term (at least 7 days look ahead) planned maintenance programs shall be:

- developed and regularly updated to cover inspection and maintenance activities of the equipment and other means that are planned to be used for the Works during the short-term period;
- submitted to Company for review.

During the mobilisation and installation/ construction Works, it shall be demonstrated that sufficient infield provisions of the spare tooling and spare parts for the repair/ maintenance of the major equipment (like tensioners, winches, cranes, lifting devices, handling systems, vertical or horizontal lay systems, reeling / spooling equipment, stingers, supports and other) have been obtained onboard the Installation Spread.

Used or consumed infield spare parts shall be replaced immediately to maintain required contingency spare levels.

Cranes and winches used for pipeline and Products installation shall be equipped with non-rotational wire ropes and with certified load cells / gauges.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 37 of 132

7.2 Technical Assurance Qualification Program – TAQP

Prior to be accepted by Company and used for the Works, the Main and Assistance Installation Spread, including personnel/crew, equipment as well as any other means (tools, installation aids, materials or facility) nominated for the Works shall be validated by Company including “HQ Pipelines and Risers Entity” representative through the dedicated technical assurance qualification program (TAQP).

The TAQP shall demonstrate that an Installation Spread including personnel/crew, equipment, as well as any other means (facilities, tools, installation aids, materials and similar) proposed for the Works are suitable, operational and fit for purpose as per the Company requirements and applicable standards.

In case of the installation of pipelines/Products on the existing facility (like platform, FPSO, FSO and other) the TAQP shall cover all equipment and other means on the existing facility planned for the Works.

The TAQP shall be planned and developed in two stages for every nominated Main and Assistance Installation Spread:

- Stage 1: Pre-qualification audit;
- Stage 2: Ready for Installation audit.

Specific procedures (covering all activities related to completion of TAQP) shall be prepared by Contractor (in agreement with Company) in order to cover scope of works for the both stages of the TAQP, based on applicable:

- the Project scope of work;
- Company general specifications and PPS;
- Contractor's technical documentation for the execution of the Project scope of work;
- nominated Installation Spread for the Works;
- international standards and external documents listed in § 2;
- at the site environmental conditions.

As minimum, but not limited to, the specific procedures for the each stage of the TAQP shall provide:

- Detailed description / specification of the TAQP stage program including all audits, inspections, tests, certifications, calibration, checks, exercises and other activities related to completion of the related Stage;
- Inspection and test check lists;
- Schedule/planning for completion of the related Stage;
- Key parameters for installation of pipeline/Product systems and other related items;
- Detailed description / specification of the Installation Spread including its equipment and other means;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 38 of 132

- All necessary documentation (applicable for the related Stage) including operating procedures, manuals, data books, installation procedures, dedicated task plans, equipment specification, drawings, certificates, reports;
- Inspection and maintenance plan. Records of IMR works done during last 5 years;
- Organigram and CVs of key personnel (like Offshore Construction Manager and his assistants, Master, Chief Officers, Supervisors, Field engineers, Operation managers, Installation/construction managers and similar);
- Projects track records;
- And any other supporting information, document or similar required for the completion of the related Stage and overall TAQP;

The specific procedure for the each stage of TAQP shall be submitted to Company for approval minimum 1 month prior to the start of the related stage.

During TAQP execution, Company Representatives shall witness inspections, tests, calibrations and certification activities that are deemed of particular importance for the Works as per Company discretion.

Company may accept valid Third Party (approved by Company at the time of the related certification activities) certificates for some tests, inspections, certification and calibrations that have been conducted within the six (6) months before the start of the Works.

All monitoring / calibration instruments, sensors, gauges and similar shall be calibrated by Company approved certified authority prior to tests (valid certificates available to Company prior the tests).

Detailed IMR of the equipment (including all components and connections) and other means planned for a testing shall:

- be performed prior to tests;
- cover all components and connections of the equipment/ means like mechanical, hydraulic, electrical, pneumatic, electronic, software, hardware and other.

After audits, visual inspections or tests of the equipment (including all components and connections) and other means, in case of any doubts regarding the condition of the equipment or other means, Company may require additional inspections and tests like NDT/NDE (like MPI, UT or similar).

After completion of each stage of TAQP, dedicated report(s) providing the following shall be issued for Company verification and approval:

- summary of all findings and results of the performed TAQP activities;
- conclusions and recommendations for the future related TAQP activities;
- all supporting documentation (certificates, test reports, photos and other) for TAQP.

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 39 of 132

After completion of the TAQP it shall be issued for Company verification and approval final TAQP dossier consisting of the following documents:

- Stage 1 Pre-qualification audit report(s);
- Stage 2 Ready for installation audit report(s);
- Compliance report.

Installation Spread mobilisation process and Contractor readiness for installation (including Company approval of relevant certificates required for the start of the Works) shall not be considered as completed until Company approval of the dedicated TAQP dossier.

All anomalies identified during TAQP shall be corrected as per Company requirements prior to the completion of the Installation Spread mobilization.

If, an Installation Spread, equipment or other means that are nominated by Contractor are not accepted by Company due to negative outcome of TAQP (including all related audits, inspections, tests, calibrations and other), an alternative spread, equipment or other means shall be nominated by Contractor.

7.2.1 Stage 1: Pre-qualification audit

The Stage1 of the TAQP, "Pre-qualification audit", shall verify prior to Project award to a Contractor that the proposed Installation Spread including its personnel/crew, equipment, facilities and other means nominated for the Works are having required satisfactory level of capability to safely execute and complete the Project scope of work as per Contractor's proposals for the Project execution.

In respect to the Project scope of work and Contractor's proposal for the Project execution, the main objectives of the Stage1 shall be early Company verification (before or during the Project tender stage) of the Installation Spread:

- Capacity and condition of the equipment, facilities and other means;
- Inspection and maintenance program including the spare parts philosophy;
- HSE conditions;
- Key personnel competence (like Offshore Construction Manager and his assistants, Master, Chief Officers, Supervisors and field engineers).

Where applicable, but not limited to, during the Stage1 following Installation Spread components shall be subjected to the Company audit:

- Installation parameters monitoring system;
- Station keeping and positioning system;
- Main installation equipment like tensioners system, A&R system, supporting elements, pipe clamps, pipe hang-off systems, stinger, horizontal lay system, vertical lay system, reels, carousels and other;

General Specification		GS EP PLR 401
Installation of submarine pipelines		
Rev.: 14	Effective date: 12/2019	Page: 40 of 132

- Production areas and other facilities like fireline/ mainline, working stations and platforms, decks, offices, control cabins, NDT rooms, workshops and similar;
- The main deck and storage areas and decks used for the works;
- ROV system;
- Diving system;
- Cranes and lifting / pulling equipment (like winches, davits, etc.);
- Accommodations, offices and other facilities;
- Equipment (like pull-in winches, pulling equipment, etc.) and other means on the existing facility (like platform, FPSO, FSO and other) planned for the Work;
- Inspection, maintenance, repair logs and plans
- Spare parts philosophy and status.

During the Stage 1, at least one inspection visit of the nominated Installation Spread shall be planned and performed but depending on the inspection visit findings, Company might ask for some additional inspection visits.

Unless otherwise requested by Company, the Stage1 audit shall be based on applicable:

- Company general specifications and PPS;
- Project basic engineering documentation;
- Documents review, visual inspections, personnel interviews and desktop exercises;
- Contractor's tender technical documentation like feasibility installation analyses (for heaviest pipeline/product systems and accidental cases), installation method statements, spread / equipment specifications, projects track records, key personnel CVs and other.

All findings and recommendations / requirements shall be documented in the Stage 1 Pre-qualification audit report including deadlines for the correction of negative findings as per criticality.

The Stage 1 Pre-qualification audit shall be completed prior to the Project award to Contractor (before or during the Project tender stage).

The Stage 1 Pre-qualification audit could be waived through the Company derogation process in case proposed Installation Spread has satisfactory record of accomplishment on Company's projects with similar scope of work during past 24 months period.

7.2.2 Stage 2: Ready for Installation audit

The Stage 2 of the TAQP, "Ready for Installation audit", shall verify prior to start of the Works that the Installation Spread including its personnel/crew, equipment, facilities and other means nominated for the Works are fully compliant with the Company's requirements and applicable standards, fit for purpose, fully operational (for the whole duration of the Works), ready and available for the Works.