



Exploration & Production

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 104

Onshore pipeline systems

07	01/2011	Addition of DNV-RP-J202 for CO2 pipelines
06	10/2009	General revision
05	10/2008	Miscellaneous
04	10/2007	Miscellaneous
00	02/2001	First issue
Rev.	Date	Notes

Owner: EP/TDO/TEC

Managing entity: EP/TDO/TEC/PLR



Contents

1. Scope	6
2. Reference documents.....	6
3. Definitions and abbreviations	8
3.1 Definitions	8
3.2 Abbreviations	8
4. The System	9
4.1 Scope.....	9
4.2 Conveyed fluids	10
4.3 Main components	10
4.4 Other components	10
5. Battery Limits	11
5.1 Scope.....	11
5.2 Terminations	11
5.3 Right-of-Way (ROW).....	11
5.4 Connection with an offshore pipeline	12
6. Interfaces	12
7. Organisation of the Design	13
8. Deliverables	13
9. Design basis	13
9.1 Scope.....	13
9.2 The System.....	14
9.3 Conveyed fluids properties	14
9.4 Hydraulic data.....	14
9.5 HSE and operational requirements.....	15
9.6 Environment.....	15
9.7 Soils.....	15
9.8 Meteorology and climate.....	15
9.9 Survey, positioning and charting.....	16



9.10	Geographical data	16
10.	Applicable Prime Reference (APR)	16
11.	Alternatives	17
12.	General design requirements and principles	17
12.1	Scope	17
12.2	Specific analyses	18
12.3	Functional requirements	18
12.4	Criticality assessment	18
12.5	Designer's experience	18
12.6	Design roadmap	19
13.	Safety and environmental assessments	21
13.1	General	21
13.2	Risks and safety assessments	21
13.3	Environmental studies	21
14.	Flow assurance and thermal management	22
14.1	Hydraulic analysis	22
14.2	Pressure levels	23
14.3	Thermal management	23
15.	Pipeline route	24
15.1	Scope	24
15.2	Route survey specification	24
15.3	Pre-project routing	25
15.4	Project routing	25
16.	Pipeline diameter	26
17.	Loads	26
17.1	Scope	26
17.2	Functional loads	26
17.3	Environmental loads	27
17.4	Load cases	27
18.	Strength assessment	28



18.1	Scope.....	28
18.2	Mechanical design format.....	28
18.3	Elastic limits	29
18.4	Pressure containment.....	29
18.5	Collapse and buckling.....	30
18.6	No plastic strain is allowed in sour service conditions. Cyclic loads and fatigue	30
18.7	Adverse ground conditions	30
18.8	Steel grade and wall thickness selection	31
18.9	Aerial parts and above ground supported parts.....	31
18.10	River crossing	32
18.11	Road, Track and Rail crossings.....	32
19.	In-place stability	32
19.1	Scope.....	32
19.2	Above ground unanchored pipelines	33
19.3	Above ground anchored pipelines	33
19.4	Buried pipelines	33
19.5	Crossing of flooded areas.....	33
19.6	River crossing	33
20.	Corrosion protection.....	33
21.	Internal Coating	34
22.	Materials and components	35
22.1	Scope.....	35
22.2	Pig traps.....	35
22.3	Pig trap doors	35
22.4	Slug catchers	35
23.	The Works	36
23.1	Scope.....	36
23.2	Logistical issues.....	36
23.3	Installation methods.....	37
23.4	Trenching.....	37
24.	Material take-offs.....	38



25. Pre-commissioning	38
26. Programme	38
27. In-service inspection requirements	39
28. Repair Plan	39
28.1 Scope.....	39
28.2 Implementation	40
29. In-service onshore pipeline surveillance	41
30. Re-qualification of an existing System.....	41
30.1 Scope.....	41
30.2 Corroded pipelines.....	41
30.3 Detailed studies	42
31. Completion file	42
32. PLR Database	43
33. Other references	43
Appendix 1 Required design data.....	44



1. Scope

This General Specification is applicable to pre-project engineering, basic engineering, and construction engineering of the onshore pipeline systems.

It can also be used for a re-qualification project as defined in section 30.

The onshore pipeline system(s) are further on referred as **the System(s)** - Refer to definition in section 4.

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.

Prime References

The **Prime References** are those of the reference documents which are addressing the entire scope of **the System** design. They are identified with a **(PR)** mark-up in the following lists of reference documents.

Section 10 specifies the conditions of the use of the **Prime References** in conjunction with this General Specification.

Standards

Reference	Title
ASME B31.4	(PR) Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum gas, Anhydrous Ammonia and Alcohols
ASME B31.8	(PR) Gas Transmission and Distribution Piping Systems
ASME VIII-1	Rules for Construction of Pressure Vessel
DNV-OS-F101	(PR) Offshore standard - Submarine pipeline systems
ISO 13623	(PR) Petroleum and natural gas industries - Pipeline transportation systems
BSI PD 5500	Specification for unfired fusion welded pressure vessels - 2003

Professional Documents

Reference	Title
API RP 1102	Steel Pipelines Crossing Railroads and Highways
DNV-RP-J202	Design and Operation of CO ₂ Pipelines

**Regulations**

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP CIV 403	Temporary construction camps and associated facilities (onshore)
GS EP COR 250	Friction-reduction internal coatings for pipelines transporting non-corrosive gases
GS EP ENV 011	Environmental specification for onshore pipeline construction
GS EP ENV 111	Baseline study environmental status of an onshore site
GS EP ENV 120	Environmental impact assessment of E&P activities
GS EP EXP 311	Plant integrity - Minimum Inspection requirements
GS EP PLR 001	Documentation requirements
GS EP PLR 002	Organisation of the design works
GS EP PLR 100	Submarine pipeline systems
GS EP PLR 103	Design of submarine pipelines as per DNV-OS-F101
GS EP PLR 106	Design of onshore pipelines as per ISO 13623
GS EP PLR 107	Design and construction of pipelines in swamp and marsh areas
GS EP PLR 223	Carbon steel tees for pipelines (sweet service)
GS EP PLR 233	Carbon steel tees for pipelines (mild, intermediate and severe sour service)
GS EP PLR 403	Installation of onshore pipelines
GS EP PVV 211	Design and fabrication of pressure vessels according to ASME VIII



Reference	Title
GS EP PVV 212	Design and fabrication of pressure vessels according to BSI PD 5500
GS EP SAF 260	Design of High Integrity Protection Systems (HIPS)
GS EP SAF 261	Emergency Shut-Down and Emergency De-Pressurisation (ESD & EDP)
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems

3. Definitions and abbreviations

3.1 Definitions

Design	Means all the studies and engineering tasks to be performed either at Pre-Project or at Project level as necessary for the Works .
System	Means an onshore pipeline system comprised between one single entry point and one single delivery point; so that any other tied in pipeline shall be treated as another individual System . Refer also to section 4.
Pre-project	Means all the engineering to be performed with the aim of confirming the technical feasibility of the System , setting up a budget estimate for the Project and for the Works .
Project	Means the basic engineering, FEED, detailed engineering and construction engineering.
Works	Means the construction of the System , including the site preparation, the pre-commissioning works, and the site reinstatement works.
Battery Limits	The battery limits of the works shall be as per Project requirements. They may consist of a pipeline end manifold, pig launcher (and or receiver) or flange.
General Specification	Means any Company DGEP General Specification part of the DGEP Referential, of mandatory application on any new project.
Particular Specification	Any particular specification based on Project requirements and on instructions for the performance of the works. May be also referred to as job specification.
Alternative(s)	Means any Alternative(s) that can be proposed in the frame of the Design , and which have been clearly identified as open in the course of this General Specification. Refer to section 11 for specific requirements.
Company	Means TOTAL SA.

3.2 Abbreviations

ALARP	As Low As Reasonably Possible
AP	Abnormal/Extreme Pressure
APR	Applicable Prime Reference(s)

BL(s)	Battery Limit(s)
D	Outer diameter
DCS	Distributed Control System
DP	Design Pressure
EBS	Environmental Baseline Survey
EIA	Environmental Impact Assessment
ESDV	Emergency Shut Down Valve
HIPPS	High Integrity Pressure Protection System
ID	Internal Diameter
IR&M	Inspection, Repair, & Maintenance
LRFD	Load Resistance Factor Design
MAOP	Maximum Allowable Operating Pressure
MOP	Maximum Operating Pressure
MoU	Memorandum of Understanding
OD	Outer Diameter
OPPS	Over Pressure Protection System
PPS	Project particular specification
QRA	Quantified Risk Analysis
ROW	Right-of-Way
SCADA	Supervisory Control And Data Acquisition
SMYS	Specified Minimum Yield Stress
SRA	Structural Reliability Analysis
UHB/LB	UpHeaval Buckling and/or Lateral Buckling
VIV	Vortex Induced Vibration
WSD	Working Stress Design
WT	Wall Thickness

4. The System

4.1 Scope

The System shall consist of an onshore pipeline with a single entry point and a single delivery point. Any other tied-in pipeline shall be considered as an individual **System** which also has a single entry and single delivery point.

Design requirements for safety systems such as High Integrity Pressure Protection System (HIPPS), Distributed Control System (DCS), and Supervisory Control And Data Acquisition (SCADA) are not directly covered by **GS EP PLR 104**.

When a System or any sections of a System needs to be installed in swamp and marsh zones, **GS EP PLR 107** shall be used in place of this General Specification.

Flowlines (wellhead to separator lines) are usually covered by process piping reference documents and relevant Company General Specifications; however, as soon as the length of a flowline exceeds one kilometre - typically - the benefits from treating the flowline as a pipeline rather than a process piping shall be evaluated, as well as the consequences.

4.2 Conveyed fluids

Conveyed fluids shall only be either: crude oil, stabilised oil, commercial oil, rough gas, treated gas, condensate (stabilised or not), injection water, treated water, methanol, or glycol. Where conveyed fluids are overwhelmingly CO₂, recommended practice **DNV-RP-J202** shall be applied and used in conjunction with the APR.

4.3 Main components

The Systems are those exclusively of welded assemblies of carbon steel or equivalent line pipe. For corrosion resistant alloy or non-steel metal incorporated into or fully making the tubulars of **the System**, the limitations outlined in section 21 shall be observed. Joining of individual pipes by flanging or by threading is not allowed (re-use of new or second-hand OCTG tubings).

4.4 Other components

In addition to steel line pipes, the following components can be incorporated to form a complete onshore pipeline system:

- Aerial valves and valve pits
- Anodes (bracelets, bulks)
- Blind flanges
- Bulkheads (temporary, permanent)
- External concrete weight coating
- External corrosion coating
- External thermal insulation coating
- Impressed current stations
- In-line vents
- Installation aids (temporary, permanent)
- Insulating joints
- Internal cladding, lining or coating (corrosion, flow drag reduction)
- Markers and marking posts
- Mechanical protection devices
- Mechanical protectors (temporary, permanent)
- Monitoring devices (temporary, permanent)
- OPPS, HIPPS, etc.
- Pig traps
- Piggy back straps
- Pipeline end manifolds
- Right-of-Way
- SCADA, DCS, etc.
- Slug catchers
- Stabilising devices
- Supports, guides, clamps
- Tapped joints
- Tapping and tees
- Telecommunication means, etc.

5. Battery Limits

5.1 Scope

The Battery Limits (BLs) of the System consist of the upstream and downstream terminations (Refer to Section 5.2), and of the boundaries of the occupied grounds, that is of the right-of-way (Refer to Section 5.3).

5.2 Terminations

The Battery Limits at either ends of **the System** consist of the tie-in point to the host facilities at its either ends and they shall be treated as Interfaces in compliance with section 5.3. By default, the BL is located on the pipeline side of the connection to the ESDV. In addition:

- The branch between the ESDV and the pig launcher or receiver shall be preferably part of the System
- Depending on the Applicable Prime Reference, slug catchers and pig traps can be either treated under a pressure vessel, pipeline or piping Prime Reference
- ESDV tie-in method is defined in **GS EP SAF 261**.

All the appurtenances connected to the pipeline in the plant area (arrival and departure including intermediate areas) shall use flanged type connections and shall comply with the relevant Company General Specifications for pressure vessels and piping. When the pig trap is within **the System**, the code limit shall be at its flanges.

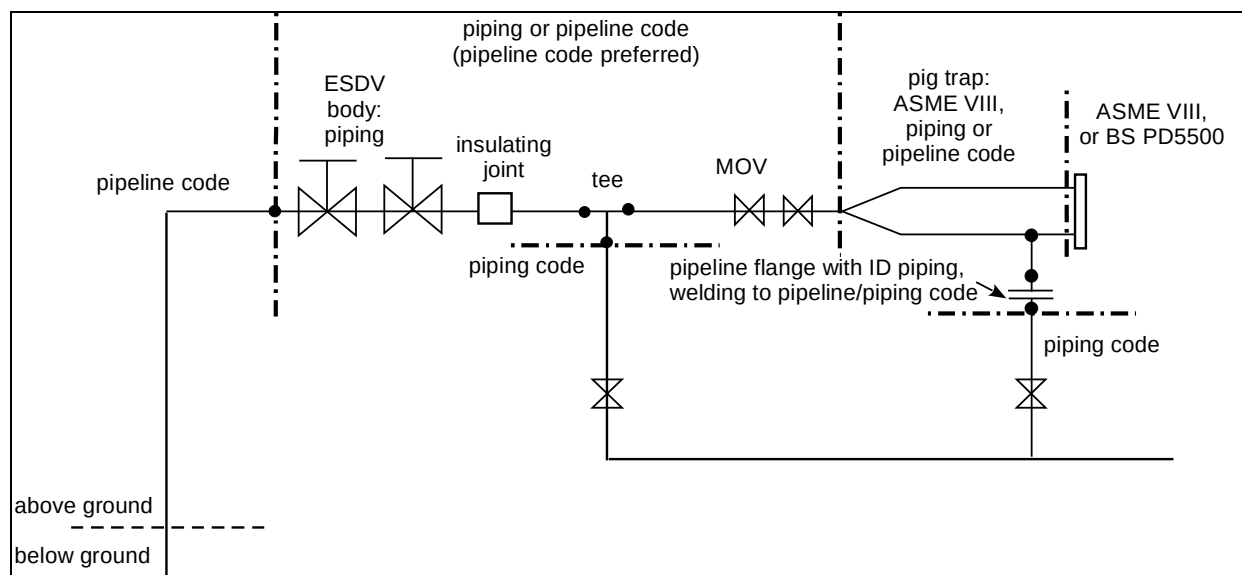


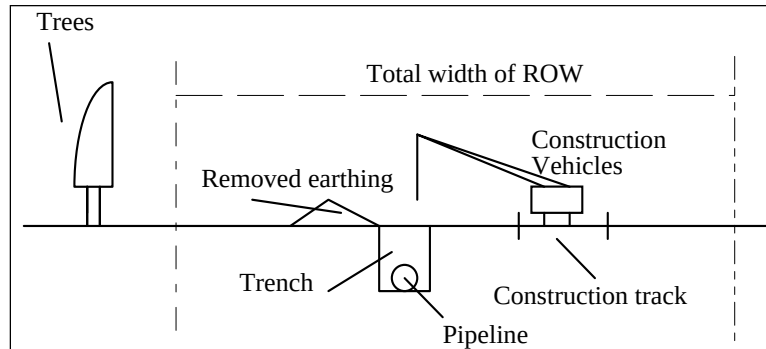
Figure 1 - Typical Battery Limits

5.3 Right-of-Way (ROW)

The ROW defines the band of terrain that shall be dedicated to the installation and operation of **the System**. The boundaries of the area covered by the ROW represent another **Battery Limit**.

General requirements regarding ROW are addressed in **GS EP PLR 403** section 5.1.

The need for maintaining the construction track during the whole life duration of **the System** must be anticipated, i.e. in the view of inspection and maintenance purposes.



5.4 Connection with an offshore pipeline

When **the System** consists of an onshore section in continuity with an offshore section, the present General Specification shall cover the onshore section whereas **GS EP PLR 100** shall cover the offshore section and the BL between either sections shall be clearly identified and treated as an **Interface** as specified in section 5.4 and in **GS EP PLR 100**.

The BL shall consist of the upstream flange or gold weld of the sectional beach valve (the latest which is itself part of the onshore line) when the flow is coming from offshore towards inland.

Presence of sectionalising beach valve at the shore line (usually located between highest astronomical sea level tide area and 200 m inland) must be defined further to a risk assessment study.

Any ancillaries, concrete works, etc., of this sectional valve shall be part of the onshore section.

The detail procedures for the landfall construction may depend on the offshore line construction scenario and procedures and upon the available constructional means (Refer to **GS EP PLR 100**).

6. Interfaces

The BLs are located at the main Interfaces. Other Interfaces shall be created whenever there is a direct contact or a potential risk of contact between **the System** and the surrounding existing facilities, communication ways, plants, human activities, etc.

Both permanent and temporary Interfaces from the initiation of the construction phase until the end-of-life period shall be identified and sorted out. Interfaces shall therefore be created at any points where there is:

- A significant disruption in the design conditions
- Especially at design code break points such as pipeline/piping, pipeline/riser, etc.
- A significant change in the behaviour of the interfaced sections, such as loadings, flowing, thermal behaviour, etc.

Interfaces shall be thoroughly and timely resolved, especially when other works are involved.

The design of an interface shall not impair the safety and the functional requirements of the interfaced sections or facilities.



The envelopes of the acceptable design parameters of the interfaced systems, sub-systems, components shall be part of the General Basis of Design (Refer to section 9). The interaction analysis shall be fully documented with an outline of the safety margins with respect to the APRs for either interfaced systems.

Pipelines fittings shall be above 2 inch size. They are treated under a pipeline Prime Reference. Refer also to appendix 3 of [GS EP PLR 223](#) and [GS EP PLR 233](#).

7. Organisation of the Design

The organisation of **the Design** shall as a minimum conform to [GS EP PLR 002](#).

The available design data shall be sufficient and consistent for **the Design** and their respective uncertainty levels shall be consistent with the required level of accuracy for **the Design**. The use of values "by default" (i.e. soil friction factors, etc.) is not permitted.

Additional working hypotheses shall be implemented and approved before any use; as such, interpolation and extrapolation methods addressing the use of the design data shall be treated as **Alternatives** (Refer to section 11).

Other additional requirements are further on specified in this General Specification.

8. Deliverables

The documentation to be produced in the frame of **the Design** shall as a minimum comply with [GS EP PLR 001](#).

The format and the organisation of the design data shall comply with the requirements and principles stated in section 12 and in [GS EP PLR 001](#).

The Particular Specifications and the Procedures shall be drafted in accordance with the Company General Specifications and with the Contract.

For a **Pre-Project**, most of these documents can only consist of outlines and method statements in the view of **the Project**.

For a **Project**, most of these documents are required at a detailed level, and fully required before the commencement of **the Works**.

9. Design basis

9.1 Scope

The format and the organisation of the design data shall comply with the requirements and principles stated in [GS EP PLR 001](#) and as such, the General Basis of Design document shall compile the design data, the applicable reference documents, the design methodology, and the design tools to be involved for the performance of **the Design**.

The data shall be detailed to the extent required by **the Design** and in compliance with the items and accuracy levels required by **the Pre-Project** or by **the Project**, as applicable (Refer to Appendix 1), and a check shall be made that the information available is adequate for design purposes.

The main input and output design data shall be reported in a follow-up datasheet - refer to [GS EP PLR 001](#).

When data absolutely needed for performance of the design is lacking, **Alternative** working hypotheses compatible with **the Pre-Project** or **Project** requirements and objectives, as applicable.

The specifications and uses of all the data listed in the present section 9, as well as any further data to be collected in the frame of **the Design**, shall comply with the relevant Company General Specifications.

9.2 The System

The initial description of **the System** shall reflect as a minimum:

- Its intended function
- The interfaced other facilities (for terminals, a provisional estimate of loading/unloading cycles shall be made) and the envisioned types of tie-ins
- Its BLs and any other special points which shall be as accurately located as possible on a geographical map
- The pipeline diameter, either as specified in the Contract or as a result of the hydraulic studies to be performed in the frame of **the Design**
- Its start-up date and service life, which shall be as per the Contract.

9.3 Conveyed fluids properties

As a minimum, the following shall be reported and used **for the Design**:

- Type and chemical composition of fluid
- Type of flow envisaged: single phase, two or three phases, etc.
- Water/hydrocarbon dew point
- Fluid specific heat and thermal conductivity
- Tabulated or graphical representation of the fluid density and viscosity at various temperatures and pressures
- Fluid compressibility
- Temperature and pressure cycles and Envelopes
- Maximum and minimum temperatures (design and operating)
- Maximum and minimum flow rates (design and operating)
- Minimum required cool-down time, maximum allowable heat losses.

9.4 Hydraulic data

As a minimum, the design basis shall incorporate as necessary to assess the design flowing conditions from which the hydraulic studies shall be performed.

If the hydraulic study is already available and if it is made clear in the Contract that the results shall be considered "as they are", this study shall be incorporated in the General Basis of Design and the results shall be part of the Design data.