

GENERAL SPECIFICATION

SUBSEA SYSTEMS

GS EP SPS 001

Subsea Production Systems General Design Requirements
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Introduction

This document provides the user with the general requirements, recommendations and guidance for the design and implementation of a Subsea Production System (SPS) for TOTAL (hereinafter referred to as Company). The document references established industry standards and specifications, and facilitates cross-referencing to relevant areas of other specifications contained within Company's General Specifications (GS) library to provide specific guidance and/or clarification.

In particular, the document provides the necessary understanding of general Company requirements regarding application of, and amendments to, the latest edition of [API RP 17A](#).

The document is laid out in a manner intended to maximise the ease of cross-referencing with [API RP 17A](#), by keeping the two top level section numberings and headings the same as for [API RP 17A](#). The wording of [API RP 17A](#) still applies, except where overridden by additional wording in this document. The requirements in this document take precedence over the API 17 series for all Company's subsea production systems. It is the responsibility of anyone who supplies equipment to this specification to ensure compliance with the requirements defined by this specification, and by other referenced standards and statutory requirements.

It is also the responsibility of any intending vendor or Contractor to rise with Company any concerns regarding interpretation of requirements for clarification, where a deviation from normal industry practice is believed to carry detrimental implications or is otherwise not recommended. Deviation from any of the requirements defined herein shall be declared and treated as a non-conformance.

This document provides general Company requirements and overall recommendations for design, manufacture, testing, inspection, installation, commissioning, operation, maintenance and abandonment of subsea production systems. It is intended as an "umbrella document" to provide an overall framework and context within which each of Company's more detailed subsea General Specifications covering specific sub-system or equipment requirements. This document shall be used in parallel with the other Company General Specifications.

This Specification is intended to establish minimum technical and functional requirements while allowing flexibility to benefit from Contractor experience and expertise.

1. Scope

The structure of the document mirrors the scope of [API RP 17A](#), which covers the complete offshore subsea production system and its subsystems. However certain sections of [API RP 17A](#) fall outside Company's subsea systems document scope and where applicable these are noted as such.

For the purpose of this Specification we refer to 'subsea' for all water depths unless otherwise specifically stated.

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2. Reference documents

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

Unless otherwise stipulated, the applicable version of the documents referred in section 1, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

This specification is supplementary to the technical specifications identified hereafter, and shall therefore be used in conjunction with said documents and any other Company specifications identified therein.

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 17A	Design and Operation of Subsea Production Systems - General Requirements and Recommendations
API RP 17H	Remotely Operated Vehicle Interfaces on Subsea Production Systems
API RP 17N	Recommended Practice on Subsea Production System Reliability, Technical Risk, and Integrity Management
API RP 17P	Design and Operation of Subsea Production Systems - Subsea Structures and Manifolds
API SPEC 17D	Design and Operation of Subsea Production Systems - Subsea Wellhead and Tree Equipment
API SPEC 6A	Specification for Wellhead and Christmas Tree Equipment
API SPEC 8C	Drilling and Production Hoisting Equipment (PSL 1 and PSL 2)
API STD 17F	Standard for Subsea Production Control Systems
API STD 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API TR 17TR13	General Overview of Subsea Production Systems
ASME B31.3	Process Piping
ASME B31.4	Pipeline Transportation Systems for Liquids and Slurries
ASME B31.8	Gas Transmission and Distribution Piping Systems
EN 10204	Metallic products - Types of inspection documents
IEC 60038	IEC standard voltages
IEC 60059	IEC standard current ratings
IEC 60076 (Parts 3; 5)	Power transformers - Parts 3; 5

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Reference	Title
IEEE 519	IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
IEEE C57.12.00	IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.90	IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
ISO 10423	Petroleum and natural gas industries - Drilling and production equipment - Wellhead and christmas tree equipment
ISO 7531	Wire ropes slings for general purposes. Characteristics and specifications
NACE MR 0175 / ISO 15156 (All parts)	Petroleum and natural gas industries - Materials for use in H ₂ S - containing environments in oil and gas production - All parts
NORSOK M-710	Qualification of non-metallic materials and manufacturers - Polymers

Total General Specifications

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

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP ELE 001	Electrical Design Criteria
GS EP FP 410	Subsea Wellhead and Guidance Systems
GS EP FP 411	Subsea Horizontal Christmas Tree System
GS EP FP 412	Workover Subsea completion systems for horizontal tree
GS EP FP 413	Subsea vertical Dual Bore Christmas Tree
GS EP FP 414	Completion / Work Over (C/WO) System for Subsea Vertical Christmas Tree on Rental
GS EP MEC 275	Multi-Phase Rotodynamic Pumps
GS EP PVV 154	Ball Valves according to API SPEC 6D or API SPEC 6A
GS EP SAF 226	Completed wells safety systems and safety rules
GS EP SPS 002	Design of Subsea Stations
GS EP SPS 004	Subsea Valves
GS EP SPS 006	Service valves in subsea stations

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Reference	Title
GS EP SPS 007	Subsea Connection Systems
GS EP SPS 008	Thermal insulation of subsea stations
GS EP SPS 009	Corrosion protection of subsea stations
GS EP SPS 010	Preservation requirements for subsea package
GS EP SPS 012	Documentation requirements for subsea stations
GS EP SPS 016	Subsea Choke Valves
GS EP SPS 018	Subsea Multiphase Flow Meter
GS EP SPS 019	Subsea production control system
GS EP SPS 023	Cleaning and flushing of hydraulic systems
GS EP SPS 024	Subsea Valve Manual Actuators
GS EP SPS 025	Subsea Valve Actuators
GS EP SPS 027	WORO spread minimum requirements
GS EP SPS 028	Obsolescence Management Plan for Subsea Production Control System
GS EP SPS 029	Metallic Materials for Subsea Production Facilities
GS EP SPS 030	Observation ROV spread minimum requirements
GS EP SPS 031	Chemical Injection Throttling Valves
GS EP SPS 032	Power Connectors, Penetrators and Jumper assemblies with rated voltage from 3 kV to 30 kV
GS EP SPS 033	Subsea Intervention Tooling
GS EP SPS 034	Well Jumper Design
GS EP SPS 035	Material specification for Duplex 22Cr and Superduplex 25Cr stainless steel subsea equipments
GS EP SPS 036	Welding of pressure and non pressure containing equipment for subsea applications
GS EP SPS 037	Welding of Duplex 22Cr and Super Duplex 25Cr Stainless Steel for subsea equipment
GS EP SPS 038	Subsea Structures design & fabrication
GS EP SPS 047	AUV Spread Minimum Requirements
GS EP SPS 048	Subsea Bolting Connections
GS EP SPS 141	Subsea Power Transformers

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Overview of Subsea Production System General Design specifications:

Total's general subsea specifications cover the conventional Subsea Production System. The purpose of the below two tables are to provide a short content description of each document, which will ease locating the correct document for the relevant part of the subsea system. The below tables contain their title, document number and short scope description for each of the most relevant documents.

GS EP SPS 001	Subsea Production Systems General Design Requirements This document provides the user with the general requirements, recommendations and guidance for the design and implementation of a Subsea Production System. The document references established industry standards and specifications, and facilitates cross-referencing to relevant areas of other specifications contained within Company's General Specifications library to provide specific guidance and/or clarification.
GS EP SPS 002	Design of Subsea Stations The purpose of this specification is to provide additional requirements for subsea stations to those specified in API RP 17P .
GS EP SPS 004	Subsea Valves This document provides general Company requirements and overall recommendations for function, design and testing of subsea valves (> 2" ND). This Specification is intended to establish the technical and functional requirements while allowing flexibility to benefit from Contractor/manufacturer experience and expertise.
GS EP SPS 006	Service valves in subsea stations This document provides general Company requirements and overall recommendations for function, design and testing of subsea valves (≤ 2" ND). This Specification is intended to establish the technical and functional requirements while allowing flexibility to benefit from Contractor/manufacturer experience and expertise.
GS EP SPS 007	Subsea Connection Systems The purpose of this document is to specify the minimum requirements and amendments thereof for the design, fabrication, testing, installation, commissioning, operation and abandonment of the subsea connection systems for Subsea Production Systems (SPS).
GS EP SPS 008	Thermal insulation of subsea stations The purpose of this specification is to provide the requirements for design, qualification, application and quality control of coatings for thermal insulation of subsea stations including X-Mas trees, interconnecting modules, manifolds, templates or subsea processing stations.

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GS EP SPS 009	Corrosion protection of subsea stations This document defines the minimum requirements for the design, installation and commissioning of external Cathodic Protection (CP) and coatings of subsea production systems.
GS EP SPS 010	Preservation requirements for subsea package The purpose of this specification is to describe the general requirements for the preservation of subsea equipment during shipment, handling, transportation and storage phases.
GS EP SPS 012	Documentation requirements for subsea stations This specification defines the minimum requirements for the supply of documentation and database to the Project. This specification covers all project phases: engineering, construction, installation, operation and maintenance.
GS EP SPS 016	Subsea Choke Valves The purpose of this specification is to define the functional, design and testing requirements of subsea choke valves. This specification covers both the retrievable insert type choke and the standard choke valve configuration to be integrated in retrievable modules.
GS EP SPS 018	Subsea Multiphase Flow Meter This specification shall apply as a technical specification to be used for Multiphase Flow Meters.
GS EP SPS 019	Subsea production control system This document describes the minimum (general, functional, design, fabrication, qualification and testing) requirements of the Subsea Production Control System (SPCS).
GS EP SPS 023	Cleaning and flushing of hydraulic systems This specification covers the minimum requirements for cleaning and flushing of hydraulic systems used for subsea equipment from manufacturing up to and including field operation.
GS EP SPS 024	Subsea Valve Manual Actuators The purpose of this Specification is to define the functional, design and testing requirements of subsea valve mechanical operators. The requirements are applicable to all operators regardless of the service of the valve assembly. This specification covers both direct drive interfaces and subsea gear boxes.
GS EP SPS 025	Subsea Valve Actuators The purpose of this specification is to define the functional, design and testing requirements of subsea valve actuators. The requirements are applicable to all actuators regardless of the service of the valve assembly. This specification covers both hydraulic and electric powered actuators, including ROV override systems.

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GS EP SPS 027	WOROV spread minimum requirements The purpose of this General Specification is to define the minimum requirements for each WOROV spread, equipment and personnel, to be installed on vessels.
GS EP SPS 028	Obsolescence Management Plan for Subsea Production Control System The purpose of this document is to define the pro-active Obsolescence Management Process as it applies to subsea production control systems and detail minimum subsea equipment vendor requirements to manage the risks of obsolescence through activities associated with: Preventing, Predicting, Resolving.
GS EP SPS 029	Metallic Materials for Subsea Production Facilities This specification describes Company requirements for the selection and fabrication of metallic materials used for subsea equipment. Particular attention is also drawn on specific material aspects to consider during projects and life of field to ensure safety, environment and production availability. This spec also includes qualification, quality assurance and quality control.
GS EP SPS 030	Observation ROV spread minimum requirements The purpose of this General Specification is to define the minimum requirements for each OBSROV spread, equipment and personnel, to be installed on any offshore installation for the following applications: Drilling support, Construction support, IMR operations, Survey applications.
GS EP SPS 031	Chemical Injection Throttling Valves The purpose of this specification is to define the functional and design requirements for Chemical Injection Throttling Valves (CITV) for subsea use including qualification and testing.
GS EP SPS 032	Power Connectors, Penetrators and Jumper assemblies with rated voltage from 3 kV to 30 kV This document is valid for high voltage, single and three-phase wet-mateable and dry-mateable AC connector, penetrator and jumper assemblies with rated voltage in the range $3.6 \text{ kV} < U_m \leq 36 \text{ kV}$. The purpose of this document is to present design requirements, Factory Acceptance Tests, qualification process, transportation /installation and operational requirements.
GS EP SPS 033	Subsea Intervention Tooling This General Specification defines the functional requirements for the Remotely Operated Tooling (ROT) required to support the installation and operation of a Subsea Production Systems (SPS). This document also encompasses the Remotely Operated Vehicle (ROV) tooling required for intervention activities and the associated interfaces required to minimise ROV operation time.

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GS EP SPS 034	Well Jumper Design This Specification defines the minimum design-, functional-, fabrication- and testing- requirements for subsea well jumpers.
GS EP SPS 035	Material specification for Duplex 22Cr and Superduplex 25Cr stainless steel subsea equipments This specification covers the material and fabrication requirements for subsea equipment made in duplex 22Cr and super duplex 25Cr stainless steel for piping and pressure containing components. This specification covers seamless pipes, fittings (tees, elbows, reducers, sweepolets), flanges, valve bodies and other components either in the form of forged products or Hot Isostatic Pressed products. It also includes quality assurance, quality control and testing requirements for the materials.
GS EP SPS 036	Welding of pressure and non pressure containing equipment for subsea applications This Specification covers the requirements for welding, heat treatment, and non-destructive examination of pressure and non pressure containing subsea equipment made of but not limited to: Carbon steels, Low alloy steels subject to post weld heat treatment or not, Austenitic stainless steels, Nickel alloy stainless steels, Overlay, Heterogeneous welding.
GS EP SPS 037	Welding of Duplex 22Cr and Super Duplex 25Cr Stainless Steel for subsea equipment This specification covers the requirements for the welding of subsea equipments made in Duplex (typically 22Cr - 05Ni) and Super Duplex (typically 25Cr - 07Ni) Stainless Steel.
GS EP SPS 038	Subsea Structures design & Fabrication This document defines the technical design, material and fabrication requirements for all subsea steel structures and subsea structural components designated as non-pressure containing structures. This document shall apply to subsea structure weighing less than 400 t in air.
GS EP SPS 047	AUV Spread Minimum Requirements The purpose of this General Specification is to define the minimum requirements for each AUV spread, equipment and personnel, to be installed on any offshore installation for the following applications: Inspection, Seabed Mapping, Survey.
GS EP SPS 048	Subsea Bolting Connections This document provides recommendations for use of bolted connections in subsea environment and specifies the minimum requirements for the management system that shall be in place to ensure integrity of the connections.

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GS EP SPS 141	Subsea Power Transformers This general specification is applicable to three-phase and single-phase liquid immersed subsea power transformers (including auto transformers) with at least one winding with rated voltages in the range $3.6 \leq U_m \leq 145$ kV and with rated power in the range 50 kVA to 100 MVA. The intention is to specify additional requirements that are not covered by IEC 60076-3, IEC 60076-5, IEEE C57.12.00 and IEEE C57.12.90. For subsea transformers where no winding has a rated voltage above 1 kV, this standard may still be applicable, either as a whole or in part. The mechanical design principles are also applicable for liquid-immersed shunt reactors.
GS EP MEC 275	Multi-Phase Rotodynamic Pumps The purpose of this specification is to define the minimum requirements for the design, construction, inspection, testing and delivery of a rotodynamic multiphase pump to be installed on the sea floor. The purpose of this specification is to clarify the requirements of API STD 610 11th ed., when applied to multiphase pumps. This document modifies or complements some requirements of API STD 610, when deemed necessary considering Company experience.

Overview of WH, XT and WO General Design specifications:

GS EP FP 410	Subsea Wellhead and Guidance Systems This document covers the minimum requirements, which shall apply for the design of the Subsea Wellhead System. The presented technical requirements shall be applicable to subsea wellhead systems to be used for subsea production and/or injection wells.
GS EP FP 411	Subsea Horizontal Christmas Tree System This document defines the technical requirements for the design, manufacture, assembly and test of the a horizontal subsea Xmas Tree systems for both production and injection (gas and water) wells.
GS EP FP 412	Workover Subsea completion systems for horizontal tree This technical specification is applicable to Workover/Completion systems for all the wells equipped with a Horizontal Christmas Tree. It defines the functional requirements to Workover/Completion equipment with associated control systems and umbilicals required to install the various Units and to perform Workover on Subsea Stations using the same type of drilling unit later on during the field life.

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GS EP FP 413	Subsea vertical Dual Bore Christmas Tree This general specification is applicable to the Subsea Conventional Christmas Tree systems (VXT) for subsea production and/or injection wells. It defines the requirements for the individual components and/or equipment Units of the VXT System. These comprise of the permanently installed subsea production equipment and associated main running tools.
GS EP FP 414	Completion / Work Over (C/WO) System for Subsea Vertical Christmas Tree This specification is applicable to Completion & Work Over systems (C/WO) for all the subsea wells equipped with a Subsea Vertical Christmas tree. It defines the functional requirements for C/WO equipment required to perform Tubing Hanger and Christmas Tree installation, as well as interventions and work over these subsea wells during the life of field.

3. Terms, Definitions, Acronyms and Abbreviations and Symbols

3.1 Terms and Definitions

For the purpose of this document, the following terms and definitions apply. The terms and definitions shall be as per [API RP 17A](#) and [API TR 17TR13](#) with the additional abbreviated terms below.

‘Barrier’	Element forming part of a pressure-containing envelope which is designed to prevent unintentional flow of produced/injected fluids, particularly to the external environment.
‘Can’	‘Can’ is used for statements of possibility and capability, whether material, physical or capable.
‘Component’	The smallest part with a specific function and on which an Inspection can be performed. For example: Stem, Stem seal, Ball, Bearing and Bolt.
‘Company’	TOTAL E&P
‘Contractor’	See Contract definition.
‘Equipment’	General term that can be applied to any hardware.
‘May’	‘May’ is used to indicate a course of action permissible within the limits of the specification. An optional course of action.
‘Module’	Can be a Component, Unit, Subsystem or System, in line with the text.
‘Shall’	‘Shall’ is used to indicate requirements which are to be strictly followed in order to conform to the specification and acceptance by all parties.
‘Should’	‘Should’ is used to indicate that among several possibilities one is the recommended as particularly suitable without mentioning or excluding

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others, or that a certain course of action is preferred but not necessarily required.

‘Spool’	A short section of pipe that connects a FLET or a FLET-TEE or a PLEM to another structure.
‘Subsea Processing’	SSP systems refer to single or multi-phase pumping systems (or compressors) or separators, whether downhole or on the seabed.
‘Subsystem’	Assembly of Units. For example: Subsea Control System, Manifold (with valves), and complete X-mas Tree (XT).
‘System’	Assembly of Sub-systems. For example: Production System, Water Injection System, Gas Injection System and Compression System.
‘Unit’	Assembly of components on which an FAT can be performed. For example: Ball valve, Actuator, Manifold frame, Actuator and Pump.
‘Well Jumper’	A short section of pipe (rigid or flexible) that connects a XT to a manifold or to a FLET / ILT.

3.2 Acronyms and Abbreviations

AC	Alternating Current
API	American Petroleum Institute
AUV	Autonomous Underwater Vehicle
BC	Blister Cracking
BOP	Blow Out Preventer
CDT	Cool Down Test
CFD	Computational Fluid Dynamics
CISCC	Chloride Ion Stress Corrosion Cracking
CP	Cathodic Protection
DAF	Dynamic Amplification Factor
DBB	Double Block and Bleed
DC	Direct Current
DNV	Det Norske Veritas
DP	Design Pressure
EFAT	Extended Factory Acceptance Test
EFL	Electrical Flying Lead
ESD	Emergency Shut Down
FAT	Factory Acceptance Test

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FEA	Finite Element Analysis
FFL	Fibre-optic Flying Lead
FL	Flying Lead
FLET	Flow Line End Termination
FMECA	Failure Mode, Effect and Criticality Analysis
GOR	Gas to Oil Ratio
GS	General Specification
HCR	High Collapse Resistance
HE	Hydrogen Embrittlement
HFL	Hydraulic Flying Lead
HISC	Hydrogen Induced Stress Cracking
HPC	Hydrogen Pressure Cracking
HSC	Hydrogen Stress Cracking
ID	Inside Diameter
ILT	In-Line Tee
ISO	International Standardization Organisation
ITP	Inspection and Test Plan
IWS	Intelligent Well System
MBR	Minimum Bend Radius
MC	Mechanical Completion
MIC	Microbiologically Influenced Corrosion
MPFM	Multi-Phase Flow Meter
MPP	Multiphase Pump
MQC	Multi Quick Connect
MWP	Maximum Working Pressure
ND	Nominal Diameter
OD	Outside Diameter
PLEM	Pipe Line End Module or Manifold
PLOT	Pre-Load Out Test
PGB	Production Guide Base
PLR	Pipeline and Risers
PPE	Personal Protective Equipment
PPS	Project Particular Specification

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PSL	Project Specification Level
PWV	Production Wing Valve
RAD	Reliability Assurance Document
RAM	Reliability Availability Maintainability
RCA	Root Cause Analysis
RGD	Rapid Gas Decompression
ROV	Remotely Operated Vehicle
ROT	Remote Operated Tool
RPCM	Ring Pair Corrosion Monitor
SBS	Subsea Department
SCC	Stress Corrosion Cracking
SCM	Subsea Control Module
SCSSV	Surface Controlled Subsurface Safety Valve
SIT	System Integration Test
SIMOPS	Simultaneous Operations
SPS	Subsea Production System
SSP	Subsea Processing
SRT	Site Receipt Test
SSC	Sulphide Stress Cracking
SSIV	Subsea Isolation Valve
SUT	Stack-Up Test
SWT	Shallow Water Test
TRL	Technical Readiness Level
UFR	Umbilical Flowline and Riser
VFD	Variable Frequency Drives
WO	Work Over

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4. Subsea Production Systems

4.1 General

Systems and interfaces are as per [API RP 17A](#) with the word *should* replaced by the word *shall*.

4.2 System Configuration

The subsystems comprising of a subsea production or injection system will include those items covered in [API TR 17TR13](#) chapter 4.1.1 with the addition of:

- Subsystem condition monitoring equipment mounted on any element of the SPS
- Processing equipment directly installed downstream of subsea tree well isolation barriers, to typically provide multiphase pumping, separation, compression, fluid sampling, sand management, pressure boosting and/or chemical injection.

4.2.1 Interfaces Description

The following interfaces within Company's organisation are in principle applicable between SPS scope (SBS department), UFR scope (PLR department) and Drilling & Wells Department (FP department In French = Forage Puits):

SPS Scope (Subsea department - SBS):

- Manifold / template
- Subsea Isolation Valve (SSIV)
- Subsea process station
- Subsea control system
- Subsea distribution system
- PLEM / Standalone manifold modules (when installed as a module separately from the pipeline)
- Connection systems
- Well jumpers
- Flying leads (electric, fibre optic and hydraulic/chemicals)
- XT including tubing hanger (shared with FP)
- WO system (shared with FP)
- Power Distribution System.

UFR Scope (PLR department):

- Pipeline
- Riser
- FLET (Connectors, Valves and Instrumentation according to SBS requirements)

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- PLEM (when installed as a part of the pipeline with header designed according to DNV pipeline code. Connectors and Valves according to SBS requirements)
- ILT (Connectors, Valves and Instrumentation according to SBS requirements)
- Spool
- Flexible lines
- Umbilical
- Power Cables.

Drilling and wells Scope (FP department):

- Wellhead

See also schematic underneath, for information only:

Note: These interfaces are mainly shown for scope split, barrier requirements are independent of scope split.