

GENERAL SPECIFICATION

Drilling & Wells

GS EP FP 411

Subsea Horizontal Christmas Tree System

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General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 2 of 34

Contents

1. Scope	4
2. Reference Documents	4
3. Introduction	7
3.1 Abbreviations	7
3.2 Definitions	8
3.3 Responsibility	8
4. System Description	8
4.1 System Overview	8
4.2 Subsea Horizontal Christmas Tree (HXT) System	9
5. HXT System Requirements	9
5.1 Introduction	9
5.2 Barrier Configuration	9
5.3 Horizontal Xmas Tree (HXT)	10
5.4 Tubing Hanger System	18
5.5 Surface Test Equipment (test stumps)	24
5.6 Transportation Skids	24
5.7 HXT Choke Killing Tool	24
5.8 Marking	25
5.9 ROV Panel and Intervention Interface	25
5.10 Tubing and Fittings	26
5.11 HXT insulation	26
6. Materials and Fabrication Requirement	26
6.1 Materials	26
6.2 XT Structure	27
6.3 Welding	27
7. Corrosion and Cathodic Protection	27
8. Test Requirements	28
8.1 Introduction	28
8.2 Qualification	28

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 3 of 34

8.3	Unit Factory Acceptance Test (FAT)	28
8.4	Christmas Tree Stack-up Test (SUT)	29
9.	Documentation and Mechanical Completion	30
10.	Quality	32
10.1	Quality Assurance	32
10.2	Quality Control	32
	Bibliography	33

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 4 of 34

1. Scope

This General Specification defines the technical requirements for the design, manufacture, assembly and test of a Horizontal Xmas Tree (HXT) System for both production and injection (gas and water) wells.

Equipment covered by this General Specification includes:

- Tubing Hangers and running tools systems.
- Horizontal Xmas Tree and running tools systems.
- Test and handling tools.
- Shipping skids, baskets and slings.

Items not included in this General Specification are:

- Wellheads.
- Open Water Intervention Riser System (OWIRS).
- Downhole completion equipment.
- Production control system (SCM, MPM, CIDV, PTT, etc.).
- Insert Chokes.
- DHPT system.
- Tie-in.

The OWIRS requirements are defined in [GS EP FP 412](#) while the Wellhead System is described in [GS EP FP 410](#).

For HXT, the connector / hub which interfaces with either the template connector, the well jumper connector or the flow line connector is covered by [GS EP SPS 007](#).

The Subsea Control Module (SCM) is covered by [GS EP SPS 019](#).

Contractor shall identify and supply any other equipment, materials, facilities, etc. deemed to be necessary or required to complete and / or ensure the satisfactory installation and operation of the HXT system and associated Installation and Workover systems.

Contractor shall supply a comprehensive listing with quantities and proposed locations of use of all equipment, jigs fixtures, etc., which are not part of the deliverables but which are deemed necessary to complete the fabrication and in-house testing activities.

2. Reference Documents

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

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 5 of 34

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 17G	Recommended Practice for Completion/Workover Riser Systems
API RP 17H	Remotely Operated Tools and Interfaces on Subsea Production Systems
API SPEC 6A / ISO 10423	Petroleum and natural gas industries - Drilling and production equipment - Wellhead and christmas tree equipment
API SPEC 17D / ISO 13628-4	Petroleum and natural gas industries - Design and operation of subsea production systems - Part 4 : subsea wellhead and tree equipment
API 17 TR8	High-pressure High-temperature Design Guidelines
ASME B31.3	Process Piping
NACE MR 0175 \ ISO 15156	Petroleum and natural gas industries - Materials for use in H2S-containing environments in oil and gas production
SAE AS4059F	Aerospace Fluid Power - Contamination Classification for Hydraulic Fluids
IOGP S-561	Supplementary Specifications to API 17D - Subsea Trees
ISO 10005	Quality management - Guidelines for quality plans
ISO 14001	Environmental management systems - Requirements with guidance for use
ISO/TS 29001	Petroleum, Petrochemical and Natural Gas Industries - Sector-Specific Quality Management Systems - Requirements for product and service supply organizations

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 6 of 34

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 356	Corrosion Protection of Fasteners
GS EP EXP 101	Pre-Commissioning and Commissioning Specification
GS EP FP 332	Specification for Wellhead & X-mas Tree Manufacturing
GS EP FP 410	Subsea Wellhead and Guidance Systems
GS EP FP 412	Workover Subsea completion systems for horizontal tree
GS EP PJC 703	Requirements for Contractor Final Documentation
GS EP SPS 001	Subsea Production Systems General Design Requirements
GS EP SPS 004	Subsea Valves
GS EP SPS 006	Service Valves in subsea stations
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 029	Metallic Materials for Subsea Production Facilities
GS EP SPS 033	Subsea Intervention Tooling
GS EP SPS 035	Material specification for Duplex 22Cr and Super Duplex 25Cr Stainless Steel subsea equipment
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

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 7 of 34

3. Introduction

3.1 Abbreviations

The following abbreviations are used in this General Specification:

BOP	Blowout Preventer
CIDV	Chemical Injection Dosing Valve
CRA	Corrosion-Resistant Alloy
DHPT	Downhole Pressure / Temperature
EDP	Emergency Disconnect Package
EFS	Electrical Feedthrough System
HP	High Pressure
HPU	Hydraulic Power Unit
HT	High Temperature
HXT	Horizontal Xmas Tree
ITC	Internal Tree Cap
IWOCS	Installation & Workover Control System
LRP	Lower Riser Package
MODU	Mobile Offshore Drilling Unit
MPI	Magnetic Particle Inspection
MPM	Multiphase Meter
MSV	Multi Service Vessel
NDT	Non Destructive Testing
OWIRS	Open Water Intervention Riser System
PCS	Production Control System
PFD	Production Flow Diagram
PGB	Permanent Guide Base
PSL	Product Specification Level
PTT	Pressure Temperature Transmitter
PWV	Production Wing Valve
QCP	Quality Control Plan
ROV	Remote-Operated Vehicle
SCMMB	Subsea Control Module Mounting Base
SCM	Subsea Control Module
SCSSV	Surface Controlled Sub-surface Safety Valve

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 8 of 34

SERS	Subsea Emergency Response System
SSTT	Subsea Test Tree
SSTLS	Subsea Test Tree Landing String
TIV	Tubing Isolation Valve
TH	Tubing Hanger
THERT	Tubing Hanger Emergency Recovery (Release) Tool
THRT	Tubing Hanger Running Tool
TRT	Tree Running Tool
WH	Wellhead
WOR	Workover Riser
XT	Christmas Tree

3.2 Definitions

See [GS EP SPS 001](#).

3.3 Responsibility

It is the responsibility of the Contractor who supplies equipment under this General Specification to ensure and document compliance with the requirements defined within this General Specification, and in other relevant standards and statutory requirements. Any deviation from any of the requirements defined herein shall be clearly documented and submitted to Company for approval.

In the event of a discrepancy between Standards and / or Specifications, the more stringent applies unless otherwise specified by Company.

This Specification is supplementary to document [GS EP SPS 001](#), and therefore has to be read in conjunction with the said document and with other Company Specifications and Standards identified therein. The relationship between the main Company documents defining the requirements applicable to the Subsea Stations is illustrated in [GS EP SPS 001](#).

The subsea HXT system has to comply with all relevant industry standards such as ISO, API and other referenced standards, unless otherwise stated by Company.

4. System Description

4.1 System Overview

The Subsea Christmas Tree System comprises a set of equipment which can be divided into two groups:

- Permanently Installed Equipment.
- Workover / Intervention Equipment.

This General Specification covers the requirements for the following permanently installed Subsea Horizontal Christmas Tree (HXT) Systems including running tools, test and auxiliary equipment:

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 9 of 34

- Tubing Hanger System.
- Horizontal Tree Assembly.

4.2 Subsea Horizontal Christmas Tree (HXT) System

The HXT system used on development projects may vary in form and function, dependent on a number of factors determined by field conditions and field development strategy. HXT system shall comply with [API SPEC 6A / ISO 10423](#) and [API SPEC 17D / ISO 13628-4](#).

This General Specification is valid for all HXT options required to form any configuration, with or without choke, flow module, etc. The various development concepts, pressure regimes and water depths may be feasible, utilizing the same HXT system, without compromising any of the requirements specified in this document and were a positive financial benefit may be demonstrated.

This General Specification should be followed as far as possible for the different configurations of HXT with upfront gap analysis completed prior to / alongside the HXT system proposed.

For HP/HT applications, the HXT system shall comply with [API SPEC 17D / ISO 13628-4](#) including additional HP/HT requirements per [API 17 TR8](#).

5. HXT System Requirements

5.1 Introduction

The Subsea HXT system is remotely controlled from the Production Control System (PCS) once the production umbilical is hooked up and the control system commissioned. During installation and workover operations performed from the drilling unit, either a BOP or EDP/LRP may be used as the Primary Well Barrier. The PCS may be partly or totally disabled, and the necessary functions (i.e. valves) controlled either from the IWOCSS or by ROV.

The HXT shall provide a pressure containing conduit for the produced or injected fluid. The HXT shall provide the ability to control and isolate the well pressure.

Vertical flow isolation and access shall be achieved by dual slick line retrievable Crown Plugs both in the Tubing Hanger or in the TH and Internal Tree Cap (ITC).

All equipment shall be designed for safe and efficient handling and make-up for the maximum operating conditions of the drilling rigs. Equipment design life shall be as per [IOGP S-561](#).

Valve configuration and operation modes for the HXT System are illustrated in Appendix 1.

5.2 Barrier Configuration

The HXT System shall be designed to operate on the mudline under the specific field conditions and operating life. Some hydraulic functions (e.g. SCSSV) supplied to the HXT may be at a higher pressure than the HXT rating, therefore the HXT system shall be designed to withstand and contain this higher pressure in the event of a failure of the primary sealing element.

Qualified Metal-to-metal seals shall be used at all primary interfaces and barriers with qualified resilient secondary seals.

The HXT System shall provide a pressure containing conduit for the produced or injected fluids.

The HXT System shall provide the ability to control and isolate the well pressure.

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 10 of 34

The HXT design shall allow for communication from annulus to production. Communication shall be established downstream the production master valve and upstream the production wing valve.

The HXT design shall ensure two closed actuated valves between annulus and production when the well is in production / injection.

Requirements for control of the different valves in the HXT system during the workover / completion and production phases are given in Appendix 1. Company SPS Project team may modify the P&ID specifically for the Project needs (additional or fewer chemical injection points, additional downhole functions, etc.) but has to keep the general design. This is both documented in the Project Particular Specification and the Gap Analysis (performed by Contractor), which are submitted to the Deepwater Product Line in HQ for joint review by both the Drilling & Wells Engineering and Operational teams for prior approval.

5.3 Horizontal Xmas Tree (HXT)

5.3.1 Horizontal Xmas Tree General Requirements

HXT provides the facility to contain and control the flow of fluid to / from a subsea well. HXT valves provide the ability to shut-off produced flow, allow communication from or between the production and annulus bore to the production facility or intervention vessel / MODU. Various types of fluid inhibitors or chemicals can be injected at the HXT or downhole to stimulate / inhibit the well. Sensors are mounted on the HXT to provide real time data of the pressures, temperatures, flow rates, etc. for the well.

This section describes the requirements applicable to the HXT assembly, consisting of the following main components:

- Master Valve Spool / Block with integral actuated master valves. Production and Annulus Actuated Wing Valves in dedicated wing valve blocks.
- HXT-to-Wellhead.
- Top re-entry hub.
- SCMMB.
- All valve requirements are covered as per [GS EP SPS 004](#), [GS EP SPS 006](#) and [GS EP SPS 016](#).
- All actuator assembly requirements are covered as per [GS EP SPS 024](#) and [GS EP SPS 025](#).
- Multiphase Flowmeter requirements are covered as per [GS EP SPS 018](#).

HXT Main Block / Spool and Wing Blocks shall be configured with valves as per [IOGP S-561](#).

Vertical flow isolation shall be achieved by use of dual crown plug design with access port between as per [IOGP S-561](#) requirements. Two options may be considered:

- Dual set plugs in the TH.
- One plug set in TH and one plug set in Internal Tree Cap.

Monitoring / test port shall be provided between installed crown plugs and TH gallery as per [IOGP S-561](#).

General Specification		GS EP FP 411
Subsea Horizontal Christmas Tree System		
Rev.: 04	Effective date: 12/2019	Page: 11 of 34

The weight and footprint of the HXT with TRT shall be minimised, to allow running from an MSV, to following values (unless agreed with Company):

- 6m x 6m footprint
- 50 Mt

The HXT is balanced in a submerged condition to allow the subsea connection to be within the tolerance specified in [IOGP S-561](#). The HXT is fitted for its intended installation during this balance test (insulated with SCM, choke valve, flow module, etc. in place).

The HXT framework is designed in such a manner that it can be handled and stored on a flat base plate and without being latched to a dedicated test / transportation stump. Dedicated sea-fastening attachment points are included on the HXT framework.

The HXT is transportable ensuring / provided that 5 tons/sq. meter is not exceeded, or in accordance with a specific project design basis for offshore transport.

The HXT-to-wellhead shall be connected to an H4 external mandrel profile.

Sealing is provided by a VX-type metal-to-metal seal gasket, with secondary sealing face (VT-type or equivalent) and is integral with the HXT main spool / block containing the master valves.

A gasket release mechanism is provided for any change-out requirements accessible via an ROV hot stab, and subsequent replacement of the VX-type gasket is possible by ROV (dedicated tools are part of the ROV tooling package supplied). The wellhead gasket is held securely and deployed with the HXT connector.

It is possible to align the HXT connector over the wellhead, with the VX gasket in place on the wellhead, without risk of dislodging the VX gasket from its profile (for example, if a ROV has to be used to replace the VX Gasket after a failed XT Connector Test).

The HXT is installed by use of a Tree Running Tool to enable running on drill pipe from MODU or wire from a vessel. The design landing speed shall be minimum of 1.5 m/s on wire.

All the replaceable units in the HXT may be changed out using dedicated tooling packages. The operation is performed with the debris cap in place, with minimum risk of damage to the equipment and without the use of divers.

For control of the HXT functions during installation and workover from the drilling unit, the IWOCS interfaces with the XT SCM via electric flying leads, during which it is able to operate the necessary valve functions on the HXT, and read all pressure and temperature gauges (HXT and subsurface). The IWOCS interfaces at the HXT hydraulically via a hydraulic flying lead, which feeds hydraulic supply to the SCM, gaining / providing access to functions not accessible by the PCS (Crown Plug Test, Tubing Hanger Seal Test, etc.).

The HXT is designed to allow integration of an insert retrievable choke valve, downstream of the production wing valve outlet. Should a multiphase meter be installed on the HXT, it should be positioned upstream of the choke.

Accessory parts of the HXT assembly – dummy hot stabs, removable / replaceable parts, test cap, cover plates, etc. – are secured using methods suitable for subsea operations, and will be supplied with securing devices to prevent objects being dropped during transportation and shipping.

The design enables communication between production and annulus via a crossover bore isolated by a remotely controlled valve, downstream of the production master valve and upstream of the production wing valve.