



Exploration & Production

GENERAL SPECIFICATION

Drilling & Wells

GS EP FP 413

Subsea vertical Dual Bore Christmas Tree

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1. Scope

This General Specification is written to cover the specifications required by both EP/OPS/FP and EP/DEV/TEC/SBS, and is thus managed and administered by both departments. OPS/FP/FP states the minimum functional requirements and the DEV/TEC/SBS states the specific component technical detail requirements.

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.

This specification does not identify all components of a complete VXT System. It is the Contractors responsibility to identify all Units which are part of their complete System, and as per their system's requirements to install and operate.

2. Reference documents

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

This technical specification is supplementary to document **GS EP SPS 001**, and shall be therefore read in conjunction with said document and other Company specifications and standards identified therein. The relationship between the main Company documents defining the requirements to the Subsea Stations is illustrated in **GS EP SPS 001**.

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

Standards

Reference	Title
ISO 13628	Petroleum and Natural Gas Industries - Design and operation of subsea production systems • Part 1, General requirements and recommendations • Part 4, Subsea Wellhead and Tree Equipment • Part 8, ROV Interfaces on Subsea Production Systems
ISO 10423	Petroleum and Natural Gas Industries – Drilling and Production Equipment – Wellhead and Christmas Tree Equipment
ISO 898-1	Mechanical Properties of fasteners made of carbon steel and alloy steel - Part I Bolts, screws and studs with specified property classes – coarse thread and fine pitch thread
SAE AS 4059 E	Cleanliness classification of hydraulic fluids



Reference	Title
NACE MR 0175/ISO 15156	Material Requirements. Sulphide Stress Cracking. Resistant Metallic Material for Oil Field Equipment
ASME VIII – DIV 1	Boiler and Pressure Vessel Code
ISO TS 29001/Q1	Petroleum petrochemical and natural gas industries—Sector-specific quality management systems—Requirements for product and service supply organizations
ISO 14001	Environmental management systems - Requirements with guidance for use
ISO 10005	Quality management systems - Guidelines for quality plans

Professional Documents

Reference	Title
API SPEC A	Specification for Wellhead and Christmas Tree Equipment
API SPEC 17D	Specification for Subsea Wellhead and Christmas Tree Equipment
API RP 17H	ROV Interfaces with Subsea Equipment

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

**Total General Specifications**

Reference	Title
GS EP COR 356	Corrosion Protection of Fasteners for Subsea & Topside Applications
GS EP PJC 703	Contractor Final Documentation Requirements
GS EP SPS 001	Design Philosophy and Requirements for Subsea Stations
GS EP SPS 002	Design of subsea structures
GS EP SPS 003	Foundation design considerations for subsea stations
GS EP SPS 006	Service valves in subsea stations
GS EP SPS 007	Tie-In 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 011	Mechanical Completion for Subsea stations
GS EP SPS 012	Documentation Requirements for Subsea Stations
GS EP SPS 015	Subsea Gate Valves and Actuators in Subsea Christmas Tree Systems
GS EP SPS 016	Subsea Insert Chokes and Associated Running and Retrieval Tools
GS EP SPS 018	Multiphase flow meter
GS EP SPS 019	Subsea Production Control System
GS EP SPS 021	Subsea mateable electrical/optical connectors
GS EP SPS 022	Environmental testing of Subsea Electronics
GS EP SPS 023	Cleaning and Flushing of Hydraulic Systems
GS EP SPS 029	Metallic Materials for Subsea Production Facilities
GS EP FP 410	Subsea Wellhead and Guidance Systems

3. Introduction

The following abbreviations are used in this specification:

AMV	Annulus Master Valve
AWV	Annulus Wing Valve
BOP	Blowout Preventer
CIV	Chemical Injection Valve
CMV	Chemical Metering Valve



CRA	Corrosion Resistant Alloy
EQD	Emergency Quick Disconnect
EDP	Emergency Disconnect Package
IWOCS	Installation & Work Over Control System
LRP	Lower Riser Package
LWI	Light Well Intervention
MIV	Methanol Injection Valve
MODU	Mobile Offshore Drilling Unit
MQC	Multi Quick Connect
PCS	Production Control System
PCV	Production Choke Valve
PFD	Production Flow Diagram
PGB	Permanent Guide Base
PMV	Production Master Valve
PWV	Production Wing Valve
ROT	ROV Operated Tool
ROV	Remote Operated Vehicle
SCM	Subsea Control Module
SCSSSV	Surface Controlled Sub Surface Safety Valve
SLV	Service Line Valve
SSTT	Sub Sea Test Tree
STT	Surface Test Tree
TCTV	Tree Cap Test Valve
TGB	Temporary Guide Base
TH	Tubing Hanger
THAIV	Tubing Hanger Annulus Isolation Valve
THRT	Tubing Hanger Running Tool
THERT	Tubing Hanger Emergency Recovery (Release) Tool
TRT	Tree Running Tool
VXT	Vertical Christmas Tree
WH	Wellhead
WROV	Work Class Remote Operated Vehicle
WST	Wellhead connector Seal Test
XOV	Cross Over Valve



XT Christmas Tree

3.1 Definitions

See **GS EP SPS 001**.

3.2 Responsibility

It is the responsibility of anyone who supplies equipment to this specification to ensure and document compliance with the requirements defined by this specification, other relevant standards and statutory requirements. Any deviation from any of the requirements defined herein shall be clearly indicated and treated as a non-conformance.

In case of discrepancy between standards and/or specifications, the more stringent applies unless otherwise specified by Company.

3.3 Documents

Documents: **GS EP SPS 002**, **GS EP SPS 003**, **GS EP SPS 006**, **GS EP SPS 010**, **GS EP SPS 011**, **GS EP SPS 018**, **GS EP SPS 021**, **GS EP SPS 022**, **GS EP SPS 023**, **ISO 13628**, **ISO 10423**, **ISO 898-1**, **NACE MR-0175/ISO 15156**, **ASME VIII-DIV1**, **SAE AS 4059 E**, **API RP 17H**, are an integral part of this document.

4. System description

4.1 System overview

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

- Permanently Installed Equipment.
- Workover/Completion Equipment.

This specification covers the following permanently installed main sub systems with running tools and auxiliary equipment:

- Tubing Hanger System, including the Tubing Hanger Running Tool.
- Subsea Vertical Christmas Tree system, including the Tree Running Tool.

The Wellhead System is covered by specification **GS EP FP 410** and specifications for the Workover/Completion equipment shall be covered in Project Particular Specifications during the Tender phase.

For the VXT, the specification does not cover the connector at the end of the flowspool which interfaces with either the template connector, or the jumper connector or the flow line connector. For this connection, reference is made to document **GS EP SPS 007**.

The Specification does not cover the Control pod. For this equipment, reference is made to the document **GS EP SPS 019**, Specification for Production control System.

4.2 Subsea Conventional Christmas Tree (VXT) system options

The VXT systems shall be used on development projects which may vary in form and function, dependent on a number of factors determined by field conditions and development strategy.



This specification is valid for all VXT options required to form any configuration, with or without choke, PGB, etc. The various development concepts, pressure regimes and water depths may be covered by the same Units where this is feasible without compromising any of the requirements specified in this document and where a positive cost benefit can be demonstrated.

The conventional vertical Christmas tree is considered to be dual bore. However, this specification should be followed for variations of the vertical XT design, such as slim bore wellhead Christmas Trees, as far as possible, with up front gap analysis completed prior to/with system proposal to minimize discussions as far as possible. Sub notes are included in this GS to give indication of known deviations allowable.

5. Equipment functional requirements

5.1 General requirements

The Christmas Tree system shall be remotely controlled from the Production Control System once the umbilical is hooked up and the control system commissioned. During installation and workover operations, an LRP/EDP will be used as the primary well barrier. The PCS shall be partly or totally disabled and the necessary functions either controlled from the IWOCs, or by ROV.

The TH and XT orientation shall be controlled such as all components remain interchangeable. It shall be possible to perform a full work over (completion change out) and still reconnect the same well jumper.

Valve configuration and operation modes for the Vertical Christmas Trees System are illustrated in Appendix 1.

5.2 Barrier and valve configuration

The subsea XT System shall be configured in accordance with the dual barrier element philosophy, which implies there shall be two independent barriers between the produced fluids and the environment.

The Total Generic P&ID (Flow Diagram) is provided in Appendix 1 for Oil Producer, Water Injector and Gas Injector wells. These are Total's Standardized Christmas Tree designs. Company Project group may modify the P&ID specifically for the Project needs (additional or less chemical injection points etc.), but in keeping with the general design and this shall be documented in the Project Specific Specifications, and shall be submitted to DEV/TEC/SPS & OPS/FP for prior approval.

Well flow and annulus pressure shall be controlled by gate valves in the vertical bores and the wing outlets. There shall be one automatically operated master valve in the production bore and one in the annulus bore, integral with the XT block. Vertical flow isolation shall be achieved by use of a swab valve in the production bore above the lateral production outlet, and pressure tight stingers in the Christmas Tree Cap (XTC) plugging the bores above the swab valve. The annulus bore shall have an identical configuration. The wing valves may be integral or as bolt on side wing outlets

For slim bore wellhead systems – typical to shallow water subsea systems, where it may not be possible to integrate a vertical annulus and production bore to the main block (size restrictions), wing mounted Annulus Master valve can be considered acceptable in conjunction with appropriate protection to the wing block (refer to section 6.2.7 – Christmas Tree Roof).



Primary seals on barrier elements shall be metal to metal, with elastomeric back-up. It shall be possible to test all barrier elements bi-directionally (with the exception of the XTC which can only be tested from below). Additionally, a facility to pressure test between the XTC and the swab valves from the work over control system or via ROV hot stab shall be provided. The same test lines shall provide the facility to vent any trapped pressure above the swab valves prior to retrieving the XTC. The design shall allow for communication from production to annulus. This communication shall be established between the production master valve and upstream of the production wing valve.

5.3 Tubing Hanger system

5.3.1 Tubing Hanger

- The dual bore tubing hanger shall suspend the production tubing string and provide a pressure tight fluid conduit to the tree block with the following requirements:
- The TH shall be designed to land, lock and seal inside the High Pressure wellhead housing and the production casing hanger, and thereby provide a pressure tight seal between the tubing, to the production casing and the wellhead housing.
- The TH system shall be designed to be run and retrieved inside the marine riser and Subsea BOP by means of a running tool string consisting of the following minimum elements, from bottom to top, but not limited to, elements:
 - THRT
 - TH Orientation Joint
 - Shear sub
 - Slick joint for interfacing with an annular or ram within the BOP
 - Mono Bore Workover Riser.

(Exemption for shallow water subsea system ran from Jack Up rig, where THRT / TH Orientation Joint / WOR only apply.)

- It shall be run, oriented, landed, locked and tested in a single trip by means of a simplified hydraulic controlled landing string.
- The various TH tools / Landing String shall be capable of passing through the BOP flex joint with the joint deflected to an angle of 1.0 degrees, with the TH attached.
- The TH system shall incorporate a facility providing full orientation prior to entry of the seal assemblies into the seal bores to minimize the risk of wear or damage to the seal elements.
- A soft landing system shall be considered for safe and gentle landing of the tubing hanger with seal assemblies.
- The integrity of energized seal assemblies shall be verified by pressure testing from below.
- Through bore access for the production bore, designed to allow passage of wire line tool strings for downhole work and wire line plugs, shall be provided. The minimum bore diameter and the production bore plug profile shall be detailed in the Project Particular Specifications.



- Specific requirements for a tubing hanger annulus isolation device are further presented in section 6.1.2 - TH Annulus Isolation Device. Through bore access for the annulus bore shall be designed only to enable the installation of wireline plugs, using the appropriate contingency tooling for bore selection, where it is deemed necessary to incorporate a secondary means or isolation device.
- The TH shall include protection of all hydraulic, chemical and electrical connections when the TH is being handled at the rotary table for interfacing with hang off plate/split bushings, and on entering into the wellhead and landing on the casing hanger to prevent any snagging or collision which may cause damage to these lines.

5.3.2 Tubing Hanger Running Tool

- The THRT shall incorporate functions to lock/unlock the TH to wellhead, provide a positive lock down verification by means of a circuit or verification of full lock test line or similar, test the TH seals and latch/unlatch onto/from the TH.
- The THRT shall be designed to orientate land and latch into a locked tubing hanger. The system shall be designed to ensure adequate orientation in re-entry situations and to prevent damage to the stab subs and couplers.
- A protective can shall be implemented to protect the umbilical termination. It shall be designed for ease of installation and removal and prevent snagging during running and retrieval through the marine riser and BOP.
- A protective cap shall be provided for the lower end of the THRT. This cap shall be suitable for supporting the THRT/orientation joint and a riser joint when racked back in the derrick, and shall allow for all down hole functions provided by the THRT to be tested off line.

5.3.3 TH Accessory Tooling

- **Lead Impression Tool** - The TH system shall include a tool for measurement of casing hanger elevation relative to TH lockdown profile prior to running the completion, and the means to adjust the TH landing shoulder, to accommodate variations in the production casing hanger setting position.
- **TH Test / Inspection Stand** - Accommodate the TH in vertical position with the production pup joint and any possible pig tails attached (by means of mouse hole /elevated deck area with cut out if required).
 - Allow access for general cleaning and inspection of the TH assembly and easy change out of the TH seals arrangement.
 - Provide access for make-up of the THRT during shop floor conditions.
 - Provide access to TH test caps for test line (hot line) make-up/break out.
 - Provide access to enable the TH to be set up regarding land off ring adjustment.
- **TH Handling / Test Tool** - The TH Handling Tool shall facilitate safe and easy handling of TH both on land and offshore.

It shall be supplied capable of handling TH inclusive the complete weight of the production tubing and the downhole assembly.



- **TH Hang Off Plate / Bushings** - To achieve safe rig floor handling, the TH system shall include a false rotary designed to support the TH during completion string installation at working level to facilitate easy make-up of the THRT, without damaging the downhole function control lines and cables.
- **Tubing Hanger Elevation & Orientation Check Tool** - The TH system shall include a tool for verification of the installed TH with regard to elevation and orientation. As a base case, this should be designed to be ran by ROV once the BOP has been disconnected, and the design should be sufficient for a standard work class ROV to handle without assistance from surface.

The THEOCT shall have the means to accurately measure the alignment tolerance as angle in degrees.

- **Tubing Hanger Emergency Recovery Tool** - The TH system shall include a THERT capable of retrieving the Tubing Hanger/completion string mechanically by use of a landing string/drill pipe string. This tooling may also be known as a Mechanical Tubing Hanger Recovery Tool or Emergency Tubing Hanger Recovery Tool.
 - There shall be no requirement to use the IWOCs.
 - The THERT & landing string used shall allow for the Tubing Hanger production plug to be retrieved prior to pulling the TH/tubing assembly to surface.
- **TH / Pup Joint Test Caps** - Equipment for pressure testing of the production and annulus bores, with the production pup joint made-up, shall be included.
- **TH Shipping Basket** - The TH with pup joint shall be stored and transported in a dedicated transportation/storage steel canister designed and certified for offshore handling/storage. Seal assemblies shall be supplied in boxes providing adequate protection for offshore handling/storage in basket or container.
 - The TH transportation box shall be fabricated from steel and provide adequate protection of the TH including pre-installed pup joint including any pig tails during onshore and offshore handling and transportation.
 - The transportation box shall be designed for long-term storage of the TH.
 - It shall allow inspection of the TH seals with the transportation box and shall allow drifting of TH internal bores without removing the TH from the box.
 - It shall be designed with the objective of ensuring safe handling of the TH in offshore conditions, on drill floor or vessel deck, without the need for climbing onto the unit.
 - If required per design / intention of use of the transportation basket, It shall be possible to lift the box from horizontal to vertical position by using the slings.
 - It shall tolerate a tilt of 30° in horizontal position and 10° in upright position with a design stability safety factor of 1.3.
 - Any loose items such as covers etc. shall be secured to the structure.
 - Where the main opening for access to the TH is a hinged cover, a mechanical arrangement to lock the cover in open position shall be present. Where the main securing device for a TH is by lock down beams, adequate secondary retention devices must be fitted to ensure no dropped object potential.



- **BOP Pin** – The hydraulic function shall be obtained from the BOP control system.
 - When operated in extend position, the orientation pin shall be maintained in its end position independent of any external contact loads.
 - The orientation pin shall be fitted with a position indicator clearly visible from a ROV.
 - The orientation pin shall be equipped with an emergency retract function. Should a hydraulic emergency retract system be selected, this system shall include a ROV panel. Any required cutting loops shall be easily available for a WROV or consideration made instead to using an ROV manipulator operated valve to prevent hydraulic lock.
 - For a hydraulic system, the return system shall be isolated from the environment top prevent any seawater intrusion.
 - The intrusive part of the orientation pin shall be designed to meet long term corrosion, contact wear and external load conditions.
 - Where the BOP Pin system is not Fail Safe Retract, the BOP Pin shall incorporate an interface for a lock out tool, device or a lock out mechanism. The purpose of the tool is to hold the Pin in the retracted position on the BOP for extended phases, thus negating the need to maintain the pressure on the retract function and/or visually inspect the Pin position before every tool string is ran through the BOP.
 - Equipment for setting the THOJ orientation sleeve to the BOP Pin shall be provided. Consideration for the setting stump to be as flexible as possible in its construction to enable its use as a standalone unit for the BOP to land on, and with a flanged removable mandrel assembly that could be placed on a BOP skid / test stump. The setting stump should incorporate the same alignment guidance device as fitted to the Tree Guide Base for aligning to the BOP frame.

5.4 Vertical Christmas Tree system

5.4.1 Christmas Tree

- The Christmas Tree valves provide the facility to shut produced flow, allow communication of the production and annulus bore to production facility or intervention vessel/MODU, allow communication between production and annulus bores, in addition provide injection facilities of various types of fluid inhibitors or chemicals for well stimulation.
- The Christmas Tree shall incorporate an accurate guidance system for final guidance of the LRP, EDP and XTC.
- The Christmas Tree shall incorporate an accurate guiding system for initial and final orientation of the Christmas Tree to the TH.
 - The initial guiding system shall act between the Christmas Tree and the PGB (or host structure).
 - The final guiding system shall ensure accurate orientation between the Christmas Tree and the TH.
 - The production and annulus stab subs shall not form part of such orientation system.
- The Christmas Tree shall allow for the change out of all possible replacement units using dedicated tooling packages. The operation shall be performed, with the Christmas tree



cap, and where required, the debris cap in place, with minimum risk of damage to the equipment and without the use of divers.

- The Christmas Tree frame work shall be designed in such a manner that it can be handled and stored on a flat base, with the LRP and EDP connected, without being latched to a dedicated test/transportation stump. Dedicated sea fastening attachment points shall be included.
- The Christmas Tree shall be transportable with a dedicated transportation skid ensuring load/sq meter in accordance with specific project design basis for offshore transport where required.
- The Christmas Tree shall be balanced in submerged condition to allow the subsea connection to be within the agreed tolerances. The Christmas Tree shall be fitted for intended installation during this balance test (insulated with SCM, choke valve etc. in place).
- The tree to wellhead connector shall be capable of being connected to an H4 18- 3/4 x 27" mandrel external profile.
- Sealing shall be provided by a VX type metal to metal seal gasket, with secondary sealing face (VT type or equivalent) and shall be integral with the tree main block containing the master valves.
- A gasket release mechanism shall be provided for any change out requirements accessible via the IWOCs control system, and subsequent replacement of the VX type gasket shall be possible by ROV (dedicated tooling shall be part of provided ROV tooling package). The wellhead gasket shall be held securely and deployed with the XT connector.
- It shall be possible to align the Xmas Tree connector over the wellhead, with the VX gasket in place on the wellhead, without risk of dis-lodging the VX gasket from its profile. (for example, in the situation of requiring to replace the VX Gasket by ROV after a failed XT Connector Test.)
- The tree connector shall be designed such that it should be impossible to disconnect by an unplanned operation.
- The XTC shall be designed to be run preferably by ROV or on both drill pipe and wire.
- The XT shall be installed by use of a Tree Running Tool (TRT) either in the form of the connector on the LRP, a designated running tool run on drill pipe / work over riser, or a dedicated tool to enable running on wire from a vessel. The Project Particular specifications shall identify the types of running tools that shall be required.
- For control of the Christmas Tree functions during installation and work over, the IWOCs system shall interface with the XT SCM via electric flying leads with the ability to operate all valves on the Christmas Tree, and read all pressure and temperature gauges (at XT level, and sub surface). The IWOCs system shall interface at the XT hydraulically via a hydraulic flying lead, which shall feed hydraulic supply to the SCM, gain access to functions not accessible by the PCS (for example Production and Annulus Swab Valves), and wellhead connector test cavity.

6. Equipment technical requirement

6.1 Tubing Hanger system

- The tubing hanger system shall be designed such that the effect of trapped debris on hydraulic and electric connectors is minimized. The system shall include the necessary drill string deployed tools for cleaning if required.
- The TH system shall allow active communication with all TH and THRT functions, monitoring/test of downhole gauges, during running and installation of the TH. It shall be possible to continuously monitor / maintain pressure to the THRT/TH latch and SCSSSV open functions during the entire running/retrieval operation.
- All components of the system, including umbilical clamps and connectors shall be designed to minimize the risk of snagging, and shall have sufficient strength to avoid deformation affecting the function of the component, or loss of components in the well, in the event of snagging.
- Tension capacity of the various components of the TH system shall be as specified in the project specific design basis, to insure that it is above that of the completion tubing/running string plus margins for contingencies. Base case 350 tons.

6.1.1 Tubing Hanger (TH) assembly

The Tubing Hanger Assembly shall meet the following requirements:

- The tubing hanger seal assemblies shall utilize metal to metal seals as the primary sealing element. Elastomers may be incorporated as backup.
- The TH shall as a minimum incorporate the following bores and penetrations:
Tubing hanger penetrations are project specific. Below listed penetrations shall be apprehended as typical. Final configuration shall be presented to Company for approval.
 - 2 parallel bores for access to the production conduit and the annulus (exception for Annulus in the case of slim bore wellhead system or similar upon prior approval by Company).
 - 3 hydraulic lines for hydraulics supporting smart completion.
 - 1 hydraulic line for hydraulic supporting SCSSV.
 - 1 line for chemical injection (e.g. corrosion/scale inhibitor).
 - 1 electrical penetrator for power/signal. The connection shall be performed using metal to metal seal technology and be tested prior to being installed.
 - 1 hydraulic/test line for TH seal test.
 - 1 hydraulic line for soft landing function.
- The TH hydraulic couplers shall seal against the TH body by Metal to Metal seal as primary and an elastomeric as back up seal.
- The termination design (thread type etc.) for the downhole hydraulic connections shall be detailed in the Project Particular Specifications.



- The down hole gauge type and design shall be detailed in the Project Particular Specifications.
- There shall be no check valves in the SCSSV line. The receptacle in the TH shall be self venting. Termination at the bottom of the TH shall be of metal to metal type and pressure tested prior to being installed. Type of connection to be used shall be presented Company for approval. The stab coupler design shall eliminate the risk of marine riser/completion fluids entering the SCSSV line.
- The TH shall be supplied with a production pup joint with premium thread. The TH shall be supplied with sufficient material for at least one thread re-cut. The threads shall be protected with an appropriate anti-galling compound. Length and thread type on the pup joint will be defined by each project specific design basis. The connection shall be pressure tested before delivery.
- If a self locking taper type of mechanism is used to lock the TH into the wellhead, a secondary mechanical locking arrangement shall be incorporated as back-up to the self locking taper. This lock down mechanism shall prevent movement of the TH resulting from loads acting on the TH. The Supplier shall specify and document the lock down capacity of the Tubing Hanger. The lock down capacity should also be stated as a maximum 'Pressure vs. Temperature' graph in the annulus considering the well design in the Tender.
- For hydraulic communication between the TH and the THRT the following requirements shall apply:
 - All connections (male and female) shall be designed to minimize ingress of sea water.
 - The seals of the THRT control line penetrators to TH control line receptacles shall be of elastomeric material.
 - The connector on the tubing hanger shall incorporate a reusable seal.

6.1.2 TH Annulus Isolation Device

Contractor shall offer a primary remote controlled annulus closing device that allows communication, monitoring or venting of the annulus casing, as well as isolation. The annulus bore may feature a secondary closing device independent of the primary one. Flow by area across the closing device shall be as close as possible to the equivalent 2" annulus bore cross section.

- Annulus isolation device is to be located in the TH.
- Be hydraulically or mechanically operated.
- Include a contingency open/lock function should primary method fail.
- Be demonstrated to be drilling riser debris and particulate wear tolerant whilst maintaining sealing capabilities.
- Be qualified to seal annulus from below and above equivalent to **API SPEC 6A** valve, appendix F, performance PR2.
- Be resistant to gas decompression and opening with gas differential pressure.
- Materials to be consistent with TH selection for field life.



- Be fully field proven to a level and performance fully agreed to by Company, or subject to an agreed, fully comprehensive qualification program.

6.1.3 Hydraulically Operated Tubing Hanger Running Tool (THRT) System

- The THRT shall incorporate a hydraulically operated latch to the TH and provide pressure tight seals for the production and annulus bores.
- The THRT shall have adequate capacity to support the total weight of the TH and the production tubing string and to accommodate an emergency pull. Minimum load capacity 700,000lbs (unless otherwise stated by the project specific specification).
- In the event of latch pressure being lost the THRT shall remain latched to the TH.
- All interface connections in the TH system, i.e. TH/THRT and THRT/orientation joint, shall be stab connections with elastomeric seals.
- The THRT shall be designed with a secondary THRT to TH unlatch function. The function shall be designed independently of the primary unlatch.
- The THRT system shall be able to withstand a pressure test via the BOP choke/kill line with the annular bag or a pipe ram closed at the TH working pressure.

6.1.4 THRT Bottom Test Cap

- A THRT test stand shall include connections for testing of all hydraulic lines and electric lines of the THRT system. This Test Stand shall be suitable for supporting and testing the THRT/orientation joint and a riser joint when racked back in the derrick.

6.1.5 Tubing Hanger Emergency Recovery Tool

- The THRT shall latch on to the TH and provide pressure tight seals for the production bore and, where applicable, the annulus bore.
- It shall remain sealed to the bores after unlocking of the TH.
- It shall be possible to circulate down the production bore during recovery of the Tubing Hanger.
- It shall be designed with a mechanical strength to handle a drill string pull force of maximum 700,000 lbs (unless otherwise stated by the project specific specification).
- Contain a mechanism to allow Unlatch from the TH.



6.1.6 TH Handling & Test Tool

- The TH Handling & Test Tool shall be fitted with pressure tight seals to the down hole functions and production bore to allow pressure testing of the completion after TH make up to the completion string.
- The THHTT shall facilitate the fitment of a test plug to the TH electrical receptacle to confirm gauge communication after the electrical splice has been performed (project/gauge supplier dependent).
- The THHTT shall be fitted with a 6 5/8 Reg box thread and handling shoulder for make up to rig well control equipment.

6.1.7 TH Transportation Box

- The TH transportation box shall be fabricated from steel and provide adequate protection of the TH including pre-installed pup joint and any pre-installed pig tails during onshore and offshore handling and transportation.

6.1.8 TH Orientation Pin

- The TH system shall include a Tubing Hanger Orientation Pin for attachment to a choke and kill outlet on a BOP.

6.2 Christmas Tree system

This section describes the requirements to the dual bore Christmas Tree assembly, consisting of the following main components:

- Valve block with integral valves in the vertical production and annulus bores wing valves actuators.
- Wellhead connector.
- Re-entry hub.
- Control module mounting base.

All valves shall be capable of sealing with low pressure (150psi, as per **GS EP SPS 015**) differentials and with marginal pressure gradients.

6.2.1 Christmas Tree

- The Christmas Tree shall be 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 Christmas Tree, the same requirement will apply.
- Accessory parts on any part of the Christmas Tree assembly – dummy hot stabs, removable/replaceable parts, test caps, cover plates etc. shall be secured using methods suitable for subsea operations, and additionally be supplied with securing devices for transport and shipping that will prevent dropped objects.
- The design shall allow for communication between production and annulus via a crossover bore isolated by a remotely controlled valve, downstream the production master valve. Optionally, annulus monitoring and vent may be done by a dedicated annulus vent line. This option shall be considered project specific and be as according to the project basis for design.

- There shall be a facility for continuous injection of fluid at variable rates into the production bore downstream the wing valve via a port(s) with a dual isolation facility, to prevent production back flow into the injection line.
- The wellhead connector mechanical lock-down device shall be capable of withstanding an impact load defined by 50 kJ (700 mm dia.) acting on the tree re-entry hub.
- The flowline/service connector(s) mechanical lock-down device shall be capable of withstanding an impact load defined by 10 KJ (100 mm dia.) acting on top of the connector.
- The Christmas Tree shall include a set of dual independent pressure and temperature sensors at the following locations:
 - Upstream choke (between Production Master Valve and Production Wing Valve).
 - Downstream choke.
 - Annulus bore (between Annulus Master Valve and Annulus Wing Valve).

6.2.2 Christmas Tree Lower Connector

The subsea tree shall be equipped with an 18 3/4" wellhead connector with an 18 3/4" - 690 Bar or 1035 Bar H4 mandrel profile. Exception is for 13 5/8" Slim Bore wellhead system, where the connector profile dimensions and capacities shall be advised by the Supplier.

- The connector shall have a bending strength suitable for the specific field operation. Contractor shall verify using calculations that the connector shall maintain a preload against the wellhead above that of working pressure and static and cyclic bending loads under all operating conditions (thermal and vibration effects). Contractor shall provide Company with connector preload data presented to show the effect of friction factor at the cam ring finger/dog interface on preload for the specific type of grease utilized in this area. Contractors shall advise the number of connector operations recommended before re-application of connector grease. The bending capacity of the connector shall be high enough to withstand the bending moments induced by the installation riser/LRP-EDP as well as the shear stresses on the connector. The connector shall also withstand the tensile strength exerted during light intervention by the riser tensioners.
- The primary locking mechanism shall be mechanically or hydraulically operated. An override facility fully independent of the primary method of operation shall be provided complete with any accessory equipment. If a hydraulic connector is proposed, a secondary unlatch hydraulically operated and a mechanical secondary unlocking mechanism, ROV operated, shall be provided, complete with any accessory equipment for ROV operation (ROV mechanical override). Hydraulic systems shall be designed with tubing cutting points to avoid pressure locking when being overridden.
- An independent and secondary locking system shall be used on connectors relying on a locking taper.
- A visual indication by ROV shall be provided to enable verification that the connector is locked and unlocked.
- The hydraulic locking mechanism shall withstand the vibrations originated by all operations envisaged during field life.



- A test port fitted with ROV operated valve shall provide the ability to test the connector sealing. The valve shall be flanged directly on the tree block with a pressure rating corresponding to the rating of the connector. The test shall be carried out through the work over control umbilical or via an ROV hot-stab.
- The connector shall be designed to prevent potential hydrate formation in the connector. The connector shall incorporate a low pressure seal arrangement to prevent accumulation of any gas entrapment within the connector internal components that could lead to connector in operation through hydrate formation. Hydrate deflection has to be provided at the Permanent Guide Base (PGB) level.
- The unlocking force shall be at least 1.25 times the locking force.

6.2.3 Christmas Tree Top Hub

- The subsea tree shall be equipped with a 13 5/8" hub incorporating stab pockets and an appropriate metal gasket profile suitable for Contractors TRT / LRP lower connector.
- With reference to the emerging riser-less light well interventions systems, details of the axial, torsion and bending loads should be defined for the top hub profile, and for the Christmas Tree assembly as a whole. Reference is made to ISO 13628-7 Annex A (informative – standardisation of the CWO riser interface).

6.2.4 Christmas Tree Stab Subs

Stab subs, which connect all bores / functions between the subsea tree and tubing hanger.

- Stab subs shall interface directly with the subsea tree block.
- The DHPT connector shall be removable independently of other stabs without undue difficulty. It shall withstand both maximum pressure and maximum temperature whilst maintaining its minimum insulation resistance requirements.
- Stab subs shall be equipped with uni-directional metal-to-metal seals with bidirectional resilient back-up seals. Resilient seals shall be compatible with all fluids able to be present in the surroundings (production, completion, and work over fluids). The performance of metal seals shall be justified by tests or the submittal of existing test data.
- Control system stab subs shall be designed to prevent fluid loss or ambient fluid ingress during tree deployment. The stab subs shall allow the lines to be purged to clean control fluid once at depth, prior to connection to the wellhead.
- Stab subs length and mounting arrangements shall be compatible with all possible tree/tubing hanger orientation and elevation misalignments, which shall be fully investigated by Contractor and a report submitted to Company for review.
- Stab subs shall be designed to withstand external collapse due to the ambient pressure which would result from a leak of the fluid from a pressure conduit within the tubing hanger to tree cavity. The stab subs shall be designed to withstand an external pressure not less than the highest pressure system that transits through the tubing hanger.

6.2.5 Christmas Tree Cap

- The XTC shall seal off both production and annulus bores and act as a second barrier against the environment. Sealing shall be metal to metal, with elastomeric back up.

- The XTC shall include facilities for pressure testing after installation; provide the facility to circulate out the cavity volume and also venting of trapped pressure in the cavity between XTC and the swab valves prior to retrieval of the XTC. Isolation valves shall be ROV operated, needle type with primary metal to metal seal.

6.2.6 Debris Cap

- The tree cap running profile shall be protected by means of a debris cap, locked to the running profile. The preferred debris cap shall be designed for installation by ROV, but dependent on geographical requirements can be designed for installation by drillpipe, wire method with guidance/assistance by ROV.

6.2.7 Christmas Tree Roof

- The Tree roof assembly and any removable covers over critical retrievable components such as SCM, CMV or choke inserts shall provide protection against dropped objects.
- Protection is to be provided for a dropped object of 100mm diameter with an impact energy of 10 kJ.
- Components, which are sensitive to impact, shall be located in non-exposed positions and/or be provided with removable protective covers provided that access for maintenance is not compromised.

6.2.8 Subsea chokes

Detailed requirements for the choke and associated running/retrieval tool are described in [GS EP SPS 016](#).

6.2.9 Christmas Tree flowline/Umbilical tie-in

Detailed requirements for the choke and associated running/retrieval tool are described in [GS EP SPS 007](#).

6.2.10 Christmas Tree Running Tool

- It shall have sufficient strength to tolerate all normal and abnormal operating conditions without malfunctioning, neither structurally nor operationally during hydraulic operation.
- It shall have a primary and a secondary release function. The secondary release function can be either hydraulic or mechanical.
- It shall include means for a ROV carried release tool as a last resort
- It shall have a standard drill pipe threaded top connection, box up (or include the appropriate x-over to facilitate).
- It shall utilise the WO umbilical and associated equipment for operation.
- TRT for use during running on wire, shall incorporate functionality to install and test the XT to the wellhead without the use of the WO umbilical, i.e. via ROV hot stab panel. The TRT associated package for this function shall include all accessory equipment to use in conjunction with an ROV to enable the down hole control stabs to be flushed, at depth, to ensure clean control fluid in the lines prior to make up to the wellhead and tubing hanger.



- Hydraulic interface between TRT or LRP shall be hydraulic couplers with sealing check valves. Both the male and the female connections shall have a primary metal seal with o-ring as back-up. The design shall eliminate any possibility for seawater or debris ingress and any hydraulic lock/swabbing effects during make-up or disconnection. These hydraulic couplers can be located directly between the TRT (or LRP) and the XT, or take the form of an MQC stab plate/flying lead arrangement.
- With reference to the emerging riser-less light well interventions systems, details of the axial, torsion and bending loads should be provided for the connector, and for the upper flange connection (normally where fitted to the LRP), as this will be provided to LWI provider for integration to the LWI system. Reference is made to ISO 13628-7 Annex A (informative – standardisation of the CWO riser interface).

6.2.11 Christmas Tree Handling Tool

- The Christmas Tree handling tool shall be designed to lift the tree via the re-entry hub.
- The tool shall connect to the tree re-entry hub by a manually operated mechanical locking arrangement.
- It shall have sufficient strength to lift the XT on land and offshore with the tree connected to the test/transport skid.
- The handling tool shall be complete with a forerunner allowing safe connection to any crane at deck level.

6.2.12 Auxiliary Equipment

Contractor shall identify and include all auxiliary test equipment required to perform pre-operational checks/tests, and any special components required to install and operate the Units described in this specification, including specific tools for redressing stab seals, function testing components or elements of the VXT system offshore prior to deployment.

6.2.13 Hydraulic piping and fittings

All hydraulic system components shall be adequately designed to minimize damage, stress and vibration during testing, handling, installation/retrieval and normal operations.

The routing of all hydraulic piping shall be carefully planned to minimize the possibility of damage. Wherever possible, piping shall be clamped or run in a tray. Tubing runs to the hydraulic tree connector shall be accessible such that they can be disconnected, vented or cut in order to release locked in fluid and allow mechanical override.

Continuous lengths of piping shall be used when possible.

Fittings assembly torque is to be independently verified and sealed/secured to identify fittings that have been properly inspected. All threaded fittings shall be wire locked using 0.0035" diameter INCONEL 625 (or Project Group approved equivalent) wire to prevent vibration back out.

Fittings: "Swagelock" compression fittings type shall be agreed by Company, however piping shall be run using the minimum number of fittings.

End fittings (typically to valve actuators) shall be of metal to metal type with anti-vibration gland.



Due to line vibration caused by the stepping choke function, the choke control lines shall be welded connections with no compression fittings permitted. The line shall be firmly attached.

MeOH and any chemical injection piping shall be welded with no fittings permitted. All welds shall be full penetration.

6.3 Marking

For equipment presented in this specification, reference is made to document **GS EP SPS 001**.

6.4 Production control system

The Supplier shall refer to **GS EP SPS 019** this document for a full understanding of requirements and interfaces.

A control pod mounting base shall provide the interface between the control pod and the electric and hydraulic piping connected to the tree functions. Electrical functions may communicate with the control pod through the mounting base or may be directly connected to the control pod via electrical flying leads.

The hydraulic couplers installed at the VXT SCM mounting base shall be of self venting design causing the vertical valves (excluding swab valves) and the SCSSV to bleed down and close as a consequence of SCM retrieval. Upon re-installation of SCM, the coupler design shall allow SCM module to be installed with full operating pressure on the check valve fitted couplers (if any).

The self venting design shall eliminate the possibility of seawater ingress or any debris.

When planning the location of the control pod and mounting base, the following shall be considered:

- Access for ROV to perform functions or observation on the control module (vent ports etc.). There shall be no restriction to tree mounted functions which require ROV intervention or observation.
- The location shall facilitate retrieval/installation of the control pod, in line with the intervention philosophy.
- The control pod shall be protected from damage during tree handling and transportation, installation and retrieval, drilling and production operations.

6.5 ROV panel

ROV panel(s) should be provided on the tree for the ROV actuation of valves and interfaces, according to the following:

- The ROV panel(s) shall give access to the ROV override functions for all the remote operated valves and the choke.
- The ROV panel shall also give access to all ROV operated valves.
- The ROV panel shall also provide for any XT connector Secondary Unlock hydraulic interfaces - e.g. hot stab interface and any primary lock/unlock circuit cutting loops.
- All torque transfer mechanisms shall be designed for long term exposure to a subsea environment and shall not add significantly to the operating torque.



- The panel(s) shall include the valve and plates marking designation and shall include parking receptacles for ROV hot stabs, dummy plugs and caps, flying leads, etc. The marking system shall remain legible for the design life of the Christmas Tree. Marking shall consider the potential for marine growth. Underwater visibility shall be considered in the choice of marking colour and finish.
- ROV grab handles shall be included to assist in ROV operations. The positioning and style shall be agreed with Company Project ROV specialists, and demonstrated with ROV Accessibility study.

6.6 Tree insulation

The tree body, production and annulus wing blocks and flow loops shall be designed to provide sufficient thermal insulation.

The insulation shall meet the operating conditions throughout the designed life of field.

For specific requirements to the thermal insulation system, reference is made to Project Basis for Design and **GS EP SPS 008**.

6.7 Surface test equipment (test stumps)

Contractor shall identify and include all auxiliary and test equipment required to perform handling, transportation, pre-operational checks/tests, and any special components required to install, test and operate the Units described in this specification.

In particular, the tree surface test stand shall include mandrel profile, capable of testing the tree to its maximum WP; in order to be able to land, lock and test the tree. It shall simulate the components mating parts and provide facilities for pressure testing. The test stand shall be suitable for rig testing all the tree system functions, and for carrying out all pressure tests on pressure containing tree equipment (gate valves, isolation valves, hydraulic circuits, penetrations, bore protectors, etc.) and electric DHG testing. The XT Test Stump shall be suitable for testing of the complete XT, LRP, EDP stack up.

6.8 Transportation skids

The transportation skids shall be designed for offshore transportation of the following assemblies:

- Christmas tree.
- Tree running tool.
- Tubing hanger and running tool (optional; if so a dedicated transportation box, as specified in related paragraph, will home these equipment and fit in the tree transportation skid).

The skids shall provide protection of components against handling damage, and ease of handling for components and assemblies.

Their design shall provide lifting points for offshore transportation and ensure load capacities in accordance with specific project design basis for offshore transport. In addition to lifting points, seafastening points shall be included.



7. Material requirement

All surfaces in contact with the produced or injected fluids shall be in adherence to **GS EP SPS 029** with regard to material, trim and temperature class, based upon the project specific specifications.

	Producer and gas injector wells	Water Injector wells
PSL	3G/4	3
API temperature classification	Project specific	Project specific
API retained fluid classification	Project specific	Project specific
Working pressure (psi)	Project specific	Project specific

All sealing area shall be hard faced (CRA inlayed) as API specification.

8. Corrosion and cathodic protection

Requirements for the prevention of corrosion for the VXT system are documented in **GS EP SPS 009**, and **GS EP COR 356**.

All bolted on components shall have grounding straps to ensure continuity with the cathodic protection system.

9. Test requirements

9.1 Introduction

All Units and Systems shall be tested in accordance with the outline requirements identified in **GS EP SPS 001**, the requirements described below and the relevant industry standards. This chapter outlines minimum requirements for the testing of the main subsea Christmas Tree Units and Systems.

The Manufacturer shall make sure to provide all the equipment required to perform the tests as described in this section.

9.2 Qualification

All the VXT components and tooling not proven for the field water depth shall be qualified in accordance with industry recognized standards and Company specifications. Qualification and testing of all the components shall be associated with special procedures. Design, qualification programs, qualification results, testing programs and testing results shall be submitted to client approval.

9.3 Unit Factory Acceptance Test (FAT)

Factory acceptance test (FAT) of all Units to prove that the components of a Unit and the Unit itself, satisfy all specified requirements to strength and functional performance.



9.3.1 Christmas Tree Assembly FAT

Pressure test, function and drift test of the complete tree assembly, and fit test of tree cap, on offshore test stump, or appropriate dummy template as required, using dummy HPU or shop facilities with direct connection to SCM mounting base hydraulic and electric connections.

9.3.2 Christmas Tree Cap FAT

Pressure and function test of the tree cap assembly on test stump, using shop hydraulic test facilities.

9.3.3 PGB FAT

Pressure, and function test (if applicable) of the relevant PGB versions, using the onshore test stump.

9.4 VXT System FAT/Extended Factory Acceptance Test (EFAT)

A full system FAT shall be performed on a specified number of Christmas Tree Systems covered by this specification. The EFAT for a Christmas Tree system shall comprise the following type of tests:

- Dual Bore Christmas Tree System Test
- System Mechanical Tolerance Test.

The Christmas Tree System test shall be performed on a test stump with capability of verifying correct assembly, pressure integrity and correct functionality of the Christmas Tree assembly, comprising the tubing hanger system, the tree assembly with PGB, and the workover system. A separate test of the wellhead system shall be performed on its own.

9.5 Christmas Tree system mechanical tolerance verification test

This test shall prove that the Christmas Tree can be landed, connected to the wellhead/PGB or Template, and will hold pressure as specified, with the PGB/manifold flowline mandrel(s) in a position relative to the Christmas Tree flowline connector, representing the worst possible offset locations in the vertical and horizontal planes, as well as rotation in all three planes. The vertical PGB/manifold mandrel(s) shall not be restrained in this position. The test conditions shall be defined from the stack-up tolerance study for the Christmas Tree, wellhead and PGB or Manifold.

The test shall be repeated for two additional arbitrary offset and rotational positions of the vertical flowline mandrels or horizontal type connection at Company's discretion. The final test shall contain a 1 hour gas test in the extreme offset position, followed by a back seal test to verify pressure integrity.

10. Documentation

Full details of the required documentation requirements for a project are covered in **GS EP SPS 012** and **GS EP PJC 703**. Out with the normal project documentation requirements, the following documentation shall be provided:

Rep.	Documents to be provided	Tender	F.A.T.	Delivery
1	Itemized drawings showing all constructional, operating and mechanical features (including seal areas together with principal dimensions, including ID's, OD's, drift diameters, lengths and wall thickness.	x	1 copy	x (as built)
2	Bill of material Component part list referring to above itemization and including material list with Part Numbers.	x	1 copy	x (as built)
3	Stack up drawings. - TH in Wellhead - XT on Wellhead - Cross Sectional drawings of complete XT/TH on wellhead	x	1 copy	x (as built)
4	Spare parts list	x		x
5	Maintenance Schedule / Matrix Demonstrating and outlining the proposed maintenance schedule for each running & testing tool for routine and major maintenance schedules, highlighting manufacturers requirements for NDT and MPI testing for components under load bearing and rotation torque conditions	x		x
6	Technical data	x		x
7	Summary of the running and retrieving procedures	x		
8	Operating and maintenance manual (OMM) The OMM shall included all data required to run the field operation, as well as maintaining equipment and tools. In addition to operation procedure, it shall include #1, #2, #3, #4, #5 & #6. The documentation shall be organized in to reflect to operational sequence.	x	1 copy	x (*)

Rep.	Documents to be provided	Tender	F.A.T.	Delivery
9	Manufacturing Record Book Each piece of equipment shall be accompanied by 3 data packages which are to include as a minimum : - Certificate of conformity and non-conformance reports. - Critical dimensions inspection reports - Material and coating specifications. - Material certificates. - Heat treatment records. - NDE reports - Factory acceptance test reports.		X	x
10	Test procedures (when material is subject to hydraulic, gas or functional test).		X	
11	XT load and fatigue analysis Based on weather-ocean and rig RAO, the analysis shall demonstrate that the XT/well head system is capable to sustaining loads generated by the EDP/LRP and Work Over Riser. The fatigue design life shall be clearly presented. During Tender phase, Contractor shall present a draft document based on previous studies done for equivalent conditions.	X		X(**)
12	TH Torque Resistance Analysis	x		x
13	TH/XT Stack Up Tolerance Analysis To demonstrate correct interface between XT and TH, with correct mating of all stabs, couplers and electrical penetrations.	x		x
14	TH/XT Orientation Analysis To define maximum mis-alignment of TH in the system. To verify maximum XT connector to well jumper connector mis-alignment To verify that in the event of a complete or partial work over, that with a different XT or different TH & XT, that we make up to the same well jumper.	x		x

(*) Number of copies to be confirmed in the Tender document

(**) The study shall be performed and issued to Company for approval prior manufacturing and no later than 4 weeks after receipt of the PO. Shall contractor require some specific data, these shall be requested to Company during the tender phase.



11. Quality

11.1 Quality Assurance

The selected contractor must be able to demonstrate conformity and be auditable to [ISO TS 29001/Q1](#) and [ISO 14001](#).

11.2 Quality control

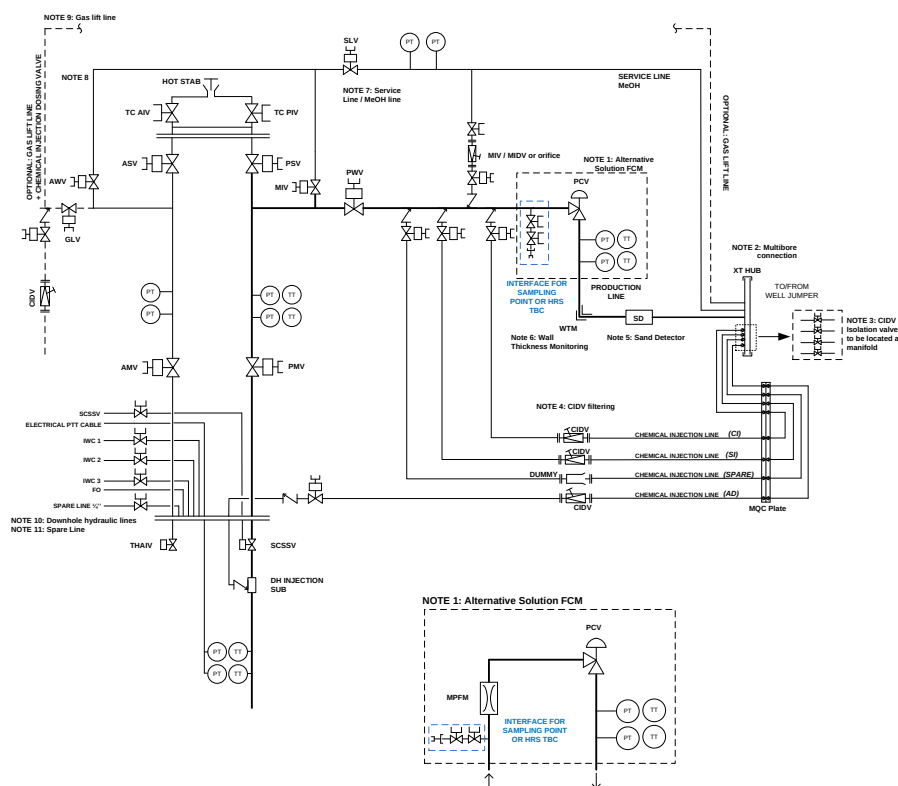
Unless a generic QCP has been agreed with FP/MTH/QAQC, Contractor shall provide a Quality Control Plan (QCP) to Company for approval. Inside this QCP will be the agreed production/testing route and the third party inspection points for Company. The QCP shall conform to [ISO 10005](#) and shall be submitted for approval prior any manufacturing & testing.

The QCP shall include, but may not be limited to, the following points.

- Witness
 - Hydro/gas tests
 - Stack up test (if any)
 - Load test (if any)
- Hold
 - Final inspection, prior shipment and packaging, on 100% of the equipment supplied
- Review
 - Manufacturing Record Book, including FAT reports
- Monitor
 - NDE,
 - Hardness tests
 - Dimensional inspection
 - Welding and associated PWHT

Appendix 1 Indicative Flow diagram for Conventional Dual Bore Christmas Tree

TOTAL GENERIC VERTICAL X-MAS TREE OIL PRODUCERS 5"x2"



NOTES:

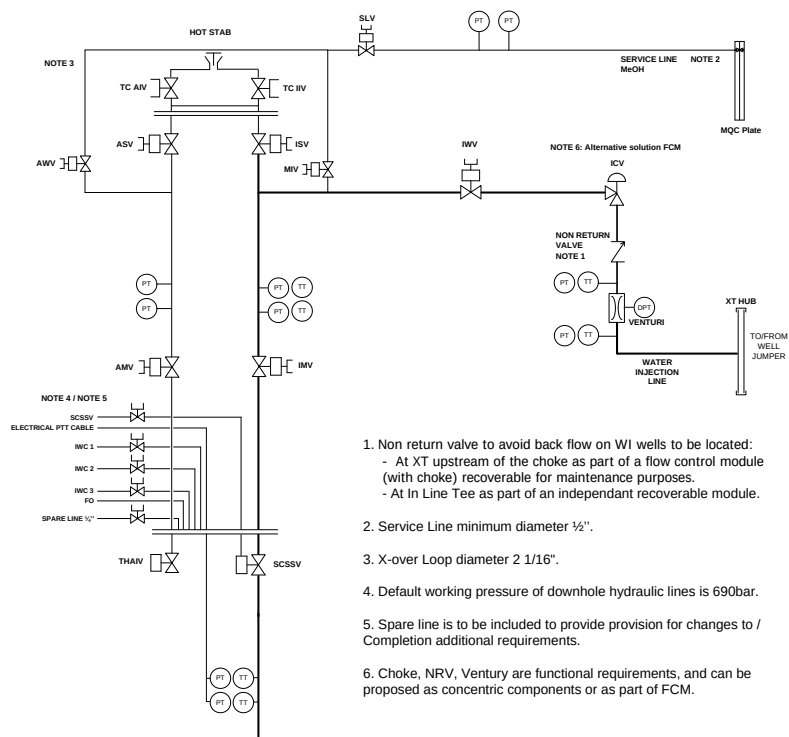
1. Full replaceable FPM is not presented on main drawing. Project to decide location either on XMT, on FCM or Manifold Module. If on XT MPFM can be located upstream or downstream of the choke depending on fluid characteristics (GOR).
2. Chemical injection, hydraulic supply, service and production line to form part of a multibore connector to well jumper module (manifold cluster) or manifold station for template option.
3. The CIDV isolation valves to be located at manifold.
4. It shall be possible to incorporate a filter according to the selected CIDV.
5. Sand detector: Acoustic type retrievable sensor. Location TBC by specific study.
6. Wall Thickness Monitoring: for erosion monitoring using external probe deployed by ROV. Location TBC by specific study.
7. Methanol Line / Service Line diameter 2 1/16".
8. X-over Loop diameter 2 1/16".
9. Gas lift line minimum 2" ID to be confirmed by Contractor.
10. Default working pressure of downhole hydraulic lines is 690 bar.
11. Spare line is to be included to provide provision for changes to / Completion additional requirements.
12. Thermal Insulation: Cool Down Time i.e. 8 hours. Contractor to propose a standard detailing associated performances.
13. MIDV & CIDV to be ROV retrievable.

ABBREVIATIONS

AD:	Asphaltene Dispersant	PCV:	Production Choke Valve
AMV:	Annulus Master Valve	PMV:	Production Master Valve
ASV:	Annulus Swab Valve	PT:	Pressure Transmitters
AWV:	Annulus Wing Valve	PSV:	Production Swab Valve
CI:	Corrosion Inhibitor	PWV:	Production Wing Valve
CID:	Chemical Injection Dosing Valve	SCSSV:	Surface Controlled Subsurface Safety Valve
DH:	Down Hole	SD:	Sand Detector
FCM:	Flow Control Module	SI:	Scale Inhibitor
FO:	Fiber Optics	SLV:	Service Line Valve
GLV:	Gas Lift Valve	TC AIV:	Tree Cap Annulus Isolation Valve
GOR:	Gas Oil Ratio	TC PIC:	Tree Cap Production Isolation Valve
HRS:	Hydrate Remediation Skid	THAIV:	Tubing Hanger Annulus Isolation Valve
IWC:	Intelligent Well Completion	TT:	Temperature Transmitters
IMV:	Methanol Injection Valve	WT:	Wall Thickness Monitoring
MIDV:	Methanol Injection Dosing Valve	XT:	Christmas Tree
MQC:	Multi Quick Connector		

	Generic Vertical Xmas Tree P&ID				
	PRODUCTION OIL				
	DATE	DRAWN	N° DESSIN	REV	
	30/08/11	J0100205	FINAL ISSUE	0	
	ECHELLE	NONE	FEUILLE	1 / 1	

TOTAL GENERIC VERTICAL X-MAS TREE WATER INJECTOR



1. Non return valve to avoid back flow on WI wells to be located:
 - At XT upstream of the choke as part of a flow control module (with choke) recoverable for maintenance purposes.
 - At In Line Tee as part of an independant recoverable module.
2. Service Line minimum diameter 1/2".
3. X-over Loop diameter 2 1/16".
4. Default working pressure of downhole hydraulic lines is 690bar.
5. Spare line is to be included to provide provision for changes to / Completion additional requirements.
6. Choke, NRV, Ventury are functional requirements, and can be proposed as concentric components or as part of FCM.

ABBREVIATIONS

AMV:	Annulus Master Valve	IWC:	Intelligent Well Completion
ASV:	Annulus Swab Valve	IWV:	Injection Wing Valve
AWV:	Annulus Wing Valve	MQC:	Multi Quick Connect
CIDV:	Chemical Injection Dosing Valve	NRV:	Non Return Valve
DH:	Down Hole	PT:	Pressure Transmitters
DPI:	Differential Pressure Transmitter	SCSSV:	Surface Controlled Subsurface Safety Valve
FCM:	Flow Control Module	SLV:	Service Line Valve
FO:	Fiber Optics	TC AIV:	Tree Cap Annulus Isolation Valve
MIV:	Methanol Injection Valve	TC IIC:	Tree Cap Injection Isolation Valve
ICV:	Injection Choke Valve	THAIV:	Tubing Hanger Annulus Isolation Valve
IMV:	Injection Master Valve	TT:	Temperature Transmitters
ISV:	Injection Swab Valve	WTM:	Wall Thickness Monitoring
		XT:	Christmas Tree

TOTAL VERTICAL X-MAS TREE GAS INJECTOR



Exploration & Production

General Specification

Date : 01/2012

GS EP FP 413

Rev : 02

Appendix 1

Abbreviation	Valve Description	Work Over Mode		Production Mode	
		Control	Failure	Control	Failure
PMV	Production Master Valve	IWOCs	FSC	PCS	FSC
PSV	Production Swab Valve	IWOCs	FSC		
PWV	Production Wing Valve	IWOCs	FSC	PCS	FSC
PCV	Production Choke Valve	IWOCs	FAI	PCS	FAI
AMV	Annulus Master Valve	IWOCs	FSC	PCS	FSC
ASV	Annulus Swab Valve	IWOCs	FSC		
AWV	Annulus Wing Valve	IWOCs	FSC	PCS	FSC
MIV (XOV)	MeOH Injection Valve/Cross Over Valve	IWOCs	FSC	PCS	FSC
CMVs	Chemical Injection Metering Valve	ROV	FAI	ROV	FAI
CIVs	Chemical Injection Valves	IWOCs	FSC	PCS	FSC
TC PIV	Tree Cap Production Bleed	ROV	FAI		
TC AIV	Tree Cap Annulus Bleed	ROV	FAI		
THAIV	Tubing Hanger Annulus Isolation Valve	IWOCs	FAI		
SLV	Service Line Valve	IWOCs	FAI	PCS	FSC