



Exploration & Production

GENERAL SPECIFICATION

Drilling & Wells

GS EP FP 410

Subsea Wellhead and Guidance System

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1. Scope

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.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

This general specification and all other equipment specifications referenced herein are based on a set of Industry standards and COMPANY internal rules identified below.

This general specification is supplementary to document **GS EP SPS 001** and shall therefore, be used 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**.

Standards

Reference	Title
ASTM D 395	Standard Test Methods for Rubber Property - Compression Set
ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 471	Standard Test Methods for Rubber Property - Effect of Liquid E
ASTM D 1414	Standard Test Methods for Rubber O-Rings R
ASTM D 2240	Standard Test Methods for Rubber Property - Durometer Hardness
NACE MR0175 / ISO 15156	Material Requirements. Sulphide Stress Cracking. Resistant Metallic Material for Oil Field Equipment
ISO 898-1	Mechanical Properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs with specified property classes - Coarse thread and fine pitch thread
ISO 10423	Petroleum and Natural Gas Industries - Drilling and Production Equipment - Wellhead and Christmas Tree Equipment Second Edition



Reference	Title
ISO 13628-1	Petroleum and natural gas industries - Design of operation of subsea productions systems - Part 1: General requirements and recommendations
ISO 13628-4	Petroleum and natural gas industries - Design of operation of subsea productions systems - Part 4: Subsea wellhead and tree equipment
ISO 13628-7	Petroleum and natural gas industries - Design of operation of subsea productions systems - Part 7: Completion/workover riser systems
ISO 13628-8	ROV Interfaces on Subsea Production Systems
ISO 140001	Environmental management systems — Requirements with guidance for use
ISO 10005	Quality management systems: Guidelines for quality plans
ISO TS 29001	Petroleum, petrochemical and natural gas industries - Sector-specific quality management systems - Requirements for product and service supply organizations

Professional Documents

Reference	Title
API SPEC 5 CT	Casing and Tubing
API SPEC 8A	Drilling and Production Hoisting Equipment
API SPEC 16A	Specification for Drill Through Equipment
API RP 16Q	Design and Operation of Marine Drilling Riser System
API RP 17H	ROV Interfaces with Subsea Equipment

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
ASME	Boiler and Pressure Vessel Code

**Other documents**

Reference	Title
DNV 2011-0063 rev1	Wellhead Fatigue Analysis Method

Total General Specifications

Reference	Title
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

3. Introduction**3.1 Abbreviations**

API	American Petroleum Institute
BOP	Blow out preventer
DTHT	Drill Through Horizontal Trees
FAT	Factory Acceptance Test
HP	High Pressure (housing)
HXT	Horizontal Xmas Tree
LP	Low Pressure (housing)
LRP/EDP	Lower Riser Package /Emergency Disconnect Package. A downhole package used for running VXTs, and allowing trough tubing interventions on VXTs and HXTs
NACE MR	National Association of Corrosion Engineers Material Requirements
PGB	Permanent Guide Base
SCF	Stress Concentration Factor
TGB	Temporary Guide base
TH	Tubing Hanger
VXT	Vertical Xmas Tree
WH	Wellhead
XMT	Xmas Tree

3.2 Responsibility

The Subsea Wellhead System shall comply with all documents referenced herein or otherwise stated in the Well Specific Specifications included in the Tender. The Well Specific



Specifications shall cover for example; wellhead size (18 ¾" standard, Large Bore or 13 5/8" Slim Bore), Christmas Tree type (vertical, horizontal, mono-bore), stand alone well or template or some particular requirements (for example cutting re-injection or heavy casing programs).

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

The specific TOTAL Representative issuing the Tender is responsible for the specification requirements. Any conflict between referenced standard and rules shall be indicated to the TOTAL Representative. The more stringent approach shall be followed unless otherwise specified.

3.3 Documents

Documents : ASTM D 395, ASTM D 412, ASTM D 471, ASTM D 1414, ASTM D 2240, NACE MR0175 / ISO 15156, ISO 898-1, ISO 13628-1, API SPEC 5 CT, API SPEC 8A, API SPEC 16A, API RP 16Q, API RP 17H, DNV 2011-0063 rev1 are an integral part of this document.

4. System description

The specification is applicable to any type of exploration and development scenario, as clearly stated within **GS EP SPS 001**.

4.1 Base Design

This specification describes the functional and technical requirements for a conventional well architecture with 2 casing hangers suspended in the high pressure housing. Additional requirements such as shallow liners, a third casing hanger, or any other item are wells specific and will be described in the Tender documents whenever required.

The wellhead system shall be identical for all subsea stations of a given project except when Cutting Re-Injection (CRI) is contemplated.

The subsea wellhead system shall incorporate the following subcomponents:

- A Guide Base which will be specific to each type of well: a Permanent Guide Base for development wells, a Temporary Guide Base for exploration wells. Note that for the particular case of a multi-well structure, there will be no requirement for a Permanent Guide Base.
- A LP (Low Pressure) Conductor Housing with a project specific extension (OD, Length, Wall Thickness, Grade, Connector type).
- A HP (High Pressure) Wellhead Housing, which shall allow accommodate 2 casing hangers with pack off seal assemblies. Specifics of the extension (OD, Length, Wall Thickness, Grade, Connector type) will be prescribed for every project.
- A 13-3/8" or 14" casing hanger and a 10 ¾ or 9 5/8 casing hanger complete with pack off seal assemblies.
- The required tooling required for the installation of all equipment: PGB or TGB together with LP housing, HP housing, casing hangers, seal assemblies, wear bushings, test tools.



- The tooling required for the testing of seal assemblies and BOPs.
- Emergency tooling (emergency drill pipe hand off tool, cement clean out tools) and emergency equipment (contingency pack off, emergency spacer hanger for light architecture, emergency wear bushing) where applicable for all sections.
- The tooling required for retrieving seal assemblies and casing hangers and for retrieving / re-orienting a Permanent Guide Base.
- Temporary Abandon (TA) equipment (trash cap, corrosion cap with capability of corrosion inhibitor injection) and associated running / retrieving tooling.
- Project specific equipment and tooling such as Drill Ahead Tool (jetting conductor and drill ahead next phase in a single run), Lead Impression Tool for space out of a tubing hanger, BOP orientation pin.

4.2 Alternate Designs

Large Bore

Where the Tender document specifies an architecture calling for Large Bore Wellhead system, all references to dimensions for housings and hangers contained within this general specification should be read considering the respective dimensions relating to said Large Bore wellhead design. The principles of specification for the additional supplementary casing hangers (either inside or outside of the HP housing) shall apply with regard to contingency equipment and installation methods. For example, emergency seal assembly requirements, and the ability to install hangers and pack offs with single trip tooling.

Slim Bore

When the Wellhead system is intended for Shallow Water subsea application, for example drilled from Jack-Up rig, a Slim Bore Wellhead system may be proposed, and thus all references to dimensions for housings and hangers contained within this general specification should be read considering the respective dimensions relating to said Slim Bore wellhead design. For example, the Slim bore system HP Housing is normally 13 5/8", but the text referring to the 18 3/4" HP housing specifications and requirements shall apply.

Cuttings Re-Injection

When the Wellhead system is to be used for CRI (Cutting Re-injection) the 30" and 18 3/4" housings shall allow a pressure tight 3" diameter flow path between the guide base and the annular area between the 13 3/8" and 18 3/4" casing strings.

The system design shall allow all seals to be tested prior to running, and all seal faces associated with the cuttings injection shall be weld overlaid. All surfaces subject to erosion from the cuttings/clean-up injection flow shall be hard faced.

It shall be noted that final selection of wellhead system architecture and implementation of a CRI system is project specific.

High pressure wellhead housing (Special Light architecture with DTHT)

The same requirements, as defined under section 5.3, shall have to be applied for the light architecture drill through wellheads and the following shall apply:

- The wellhead housing shall provide for interfaces with the Drill Through Horizontal Christmas Tree (DTHT).



- A dedicated hard faced area shall be provided as a back-up sealing area for the Drill Through Horizontal Christmas Tree (DTHT) isolation sleeve (if seated in the housing).

The exceptions are:

- ID 18-3/4 high pressure housing extension shall allow passage for a 12-1/4" bit.
- The wellhead shall withstand the additional fatigue loads induced by the additional height of the drill through horizontal tree during the whole drilling phase.
- The wellhead housing shall allow for installation of only one casing hanger with the DTHT already installed.
- Tools and wear bushings shall be designed to be installed without removing the tree protection sleeve.

5. Specific Equipment Requirements

The system shall be designed for 15Kpsi working pressure unless otherwise stated in the Tender document. This applies for the complete wellhead system including High Pressure housings, casing hangers, seal assemblies and associated tools.

The wellhead system shall withstand fatigue loading conditions imposed by the BOP / marine riser and where supplied as a development the Work Over Riser system. Supplier shall supply S-N curve and SCF as required, in addition to requirements in the Tender to validate the Wellhead Strength. Supplier shall participate with Company and Third Parties in the Global Analysis to ensure an acceptable fatigue life. Company shall provide required inputs to Supplier such as Location, Environmental Data, Soil Data, Well Architecture and Program.

The guide base and its guidance receptacle (posts or funnel) shall be designed to withstand all vertical and horizontal loads associated with deployment, installation and retrieval BOP's or XMT's, without any significant structural deformation which could affect later operations or re-entries.

Unless stated by Company, the minimum vertical tolerance of the wellhead system shall be 1.5°. All components, equipment and running tools shall be capable of performing with this maximum angular tolerance. The guide base shall be capable of providing alignment for the BOP or XMT with the wellhead at this maximum angular tolerance. Any deviation from this specification shall be advised and clearly detailed in the Tenderers technical documentation.

5.1 Guidance System

Requirements described here after apply to standalone well configurations, i.e. single satellite wells which are not drilled from a multi-well subsea structure or template. However, the principles outlined should be taken into referred to when the wellhead is system is being designed for a Project involving the supply of a template type structure.

The guide base is an element attached to and installed with the Low Pressure housing of the wellhead. All guide bases shall comply with the following general requirements:

- The Guide Base shall be installed with the LP Conductor pipe and shall have the following features :
 - Allow Conductor Pipe installation either by a drilling and cementing method or a jetting and drill ahead method.



- ID allowing running appropriate Conductor Pipe connectors (type to be specified by Company in Tender documents).
- Lock and orient to the conductor housing. Incorporate an anti rotation device to the LP housing.
- Facilitate evacuation of cuttings and cement from the next drilling phase. The locking and anti-rotation devices shall not be affected by cutting or cement during drilling and cementing of the first 2 phases of the well.
- Provide a support to suspend the Low Pressure Housing and Conductor Pipe in the moon-pool prior to being run.
- Provide a means of visual indication for verification of correct landing of the Low Pressure Conductor Housing, and fully locked guide base.
- A device e.g. bull eye mounted on the Guide Base, to allow checking Conductor Pipe verticality upon installation.
- BOP Interface
 - The Guide Base shall be designed to accommodate rigs with a BOP funnel down guidance arrangement. However, a funnel up configuration can be specified by Company in the Tender documents.
 - The Guide Base shall be designed to accommodate rigs with a 18 ¾ H4-SHD (Super Heavy Duty, the largest and strongest connector of the H4 family) wellhead connector.
 - Guideposts (if applicable) shall be replaceable with the BOP latched to the wellhead or with the XMT and LRP/EDP installed on the wellhead.
 - The Guide Base shall be designed to avoid any clash with the different BOPs planned to be used in any heading. The Supplier shall conduct an interference assessment based on 3D drawings, if requested in Tender documents.
- ROV Interface
 - The Guide Base shall include all equipment needed for ROV intervention or connection tools as defined by the Supplier in the proposed solution.
 - The Guide Base shall be designed to prevent snagging of ROV and associated umbilical.
 - The Guide Base shall incorporate a ROV docking platform for heading control during Conductor Pipe installation (for development wells only, to be confirmed by Company in Tender documents)
 - Shall be equipped with suitable interfaces (grab bars) as required to assist in ROV operations to facilitate any tasks required (especially applicable to development wells).
- PGB interface with LP Housing (applicable to development wells only). The PGB shall have the following features :
 - An orientation interface with the LP housing allowing installation in multiple orientation positions with a 360° coverage. Orientation tolerances shall be documented by Supplier.
 - Be retrievable. A dedicated tool, drill pipe conveyed shall be provided for retrieving/re-orienting/re-installing the PGB, up to the maximum 1.5° vertical tolerance.

- Be designed balanced in order to allow handling in an horizontal position
- Include lifting points for installation and/or retrieval on wire with ROV assistance
- PGB interface with XT (applicable to development wells only).
 - The PGB shall provide an orientation interface with the Xmas tree allowing to land the tree in the required heading for connection to a manifold or subsea station via a jumper.
- PGB additional features (applicable to development wells only)
 - The PGB shall be equipped with a cathodic system dimensioned to provide protection to both the guide base and wellhead for the entire life of the well.
 - The PGB will normally not sustain any load during the drilling and completion phases, as loads are transferred to the HP and LP housings. The PGB may sustain some loads once the XT is connected to a manifold or another subsea station via a production or injection jumper. Loads could be induced during the production life of the well (thermal expansion of jumper), or during an intervention or work over scenario (rig drifting of position with the jumper attached to the PGB).
 - The PGB and locking mechanism shall be able to withstand all loads induced by the scenarios identified here above

5.2 Low pressure conductor housing

The Low Pressure Conductor Housing shall have the following features

- Dimensions :
 - OD compatible with a 49 ½ rotary table
 - ID allowing running a 26" drilling bit
 - Side outlet ports compatible with the template, TGB or PGB design for disposal of the drill cuttings and the returns of the 20" casing cement job. These ports shall be located below the HP housing once the latter is locked into the LP housing. Minimum hole diameter shall be 3", quantity 4 off.
 - Incorporate an outside shoulder allowing handling with a side door elevator or Suppliers provided hang off clamp.
 - Optional : landing shoulder for running top hole liner (project specific to be specified in Tender document whenever required)
 - The Supplier shall indicate the number of slots around the top of the LP housing that can be used for the PGB, giving the equivalent maximum mis-orientation tolerance.
- Mechanical:
 - Incorporate a profile allowing to latch and lock the HP housing
 - Incorporate an internal profile allowing running with a conductor running tool or a drill ahead tool with sealing functionality between the LP housing and running tool.
 - Incorporate an external device allowing to lock and orient to the PGB (refer to section 5.1 Guidance System)



- Capable of supporting all loads induced during drilling and completion operations. The LP housing shall be capable of supporting all casing weights including hydraulic effects (piston effect while bumping cement or testing green cement) and the loads induced by the BOP and marine riser.
- The Supplier shall indicate the fraction of loads which can be transferred from the HP housing to the LP housing. Requirement for preloading of the HP housing into the LP housing shall be assessed.
- LP housing extension
 - OD, Length, Wall Thickness, Grade, and Connector type to be specified by Company in Tender document
 - High strength connectors with a low stress concentration factor to be selected for situations where fatigue issues arise (to be specified by Company in Tender document)
 - Extension shall be factory welded to the Conductor Housing. Refer to section 9.2 for welding and inspection information.
- Additional features
 - Provide electrical continuity to the High Pressure wellhead housing.
 - A sealing device between the LP housing and the Guide Base for hydrate protection.
 - For template applications, where the lock down device of the LP housing may be part of the LP housing assembly, the lockdown mechanism shall be designed to allow for release in case the conductor string needs to be pulled. Where the lock down mechanism is part of the template, the same principle applies.
 - Pad eyes for handling the conductor to the rig floor should be avoided.

5.3 High Pressure Wellhead Housing

The 18-3/4" Wellhead Housing shall have the following features;

- Mechanical and geometrical features:
 - Minimum inner drift diameter of 446.20 mm (17.567") as per [ISO 10423](#).
 - Provide adequate by pass area to fit with the ports in the LP housing (cementing of the surface casing run with the HP housing typically 20" or 18 5/8")
 - Rated 15,000 psi internal pressure, H₂S service.
 - Vetco H4 external profile suitable for the installation of a 15 Kpsi Super Heavy Duty connector (H4-SHD) the largest and strongest connector of the H4 family. The wellhead housing shall withstand the clamping force from the 15 Kpsi H4-SHD connector without reducing the ID of the HP housing.
 - Incorporate an external profile allowing to latch and lock into the LP housing.
 - Include a visual landout indicator which clearly indicates that the High Pressure wellhead housing is fully landed inside the Low Pressure Housing.
- Casing program
 - The wellhead housing shall allow for installation of two casing hangers, typically 13-3/8" (or 14") and 10-3/4" (or 9 5/8").



- Optional: capability for a third casing hanger will be described in Tender documents whenever applicable.
- Include a positive landing shoulder for the first run casing hanger.
- The system shall be designed to take full load from the specified casing program imposed via the casing hanger landing shoulder. The Supplier shall provide the maximum axial loads which can be supported by the system.
- Pressure containment and integrity
 - Include a top sealing face to the Christmas Tree or BOP connector that shall be a double VX-VT (or equivalent) sealing profile lined with corrosion resistant nickel based alloy. The VX seal preparation shall be the primary sealing surface, the VT being the secondary seal surface.
 - Both gaskets (nominal and back up) shall resist backside to the water hydrostatic pressure with atmospheric pressure in the cavity.
 - Provide seal surfaces appropriate for the Suppliers pack off sealing systems and for all seals associated with test and running tools.
- HP housing extension
 - OD, Length, Wall Thickness, Grade, and Connector type to be specified by Company in Tender document.
 - Extension shall be factory welded to the HP housing. Refer to section 9.2 for welding and inspection information.
 - and plant tested (hydro test) to the high pressure housing.

Optional to be specified in Tender document: If the addition of a weld on fin type centralizer for mechanical purpose, reduction of bending moments on connector and extension is required, the position of the fin shall be minimum 18" above the connector to allow placement of casing tong.

5.4 Casing hangers

The following requirements shall apply for the casing hangers (13-3/8" or 14" and 10-3/4" or 9 5/8):

- Have a minimal internal diameter equivalent to the attached casing.
- The casing hanger shall be designed to allow for returns during cementing operations through a flow-by area. These areas shall be designed to be as close as possible to the flow area between the casing collars and the ID of the previously installed casing.
- The different casing hangers shall be individually locked in the high pressure wellhead housing. Lock down capacity of the casing hanger and pack off assembly shall be documented by the Supplier.
- Capability to install a dummy 13 3/8 casing hanger for light architecture wells (only the production casing is suspended in the HP housing). The dummy hanger (without a seal assembly) shall be installed below the 10 3/4 or 9 5/8 casing hanger and installed in a single trip together with the production casing
- For the production casing, the casing hanger internal seal preparation shall be inlaid with corrosion resistant nickel based alloy for future potential Tubing Hanger sealing system.



The casing hanger seal areas shall be protected during drilling and down hole completion activities.

- Casing hanger extension. The type of extension will be specified by Company in the Tender documentation;
 - Thread type. The casing hanger shall incorporate a tonguing neck allowing for make up with casing tongs.
 - The casing hanger shall be supplied with a box thread unless otherwise stated in the Tender documents.
 - Requirement for delivery with a pin down pup joint pre-assembled to the casing hanger. Pup joint length and make up torque shall be specified by Company
- Optional: there may be a particular requirement for the ID of the extension joint below the casing hanger to accommodate the eccentricity of the tubing bore for a dual bore VXT. This will be detailed in the Tender documents, but should be considered by the Supplier when designing the wellhead system as part of the development project. Allow for pre-assembly of the casing hanger, the seal assembly and the casing hanger running tool onshore.

5.5 Casing hanger Pack-Off / Seal Assemblies

The casing hanger pack-off/seal assemblies shall comply with the following requirements:

- Casing hanger primary seal assemblies shall be designed with a full metal to metal seal between the individual casing hanger and the HP housing.
- The primary seal assembly shall be gas tight from above and below without the requirement to fit back up elastomeric seals. Supplier shall indicate and document the corresponding maximum working pressures from above and below.
- The Casing Hanger / Pack Off lock down capacity shall be specified and documented by Supplier. This lock down capacity should also be stated as a maximum allowable 'pressure vs Temperature' graph in the annulus considering the well design issued in the Tender.
- The same design of seal element shall be used for both casing hangers. The seal element shall be manufactured from an alloy steel compatible with the corresponding sealing area within the HP housing
- The complete seal assembly shall be retrievable in case of initial failure to achieve the required pressure test or in case of well abandonment
- Emergency pack off
 - An emergency pack-off seal assembly (design to be specified) shall be available to cater for cases where pressure integrity cannot be achieved with the primary metal to metal pack-off.
- The emergency pack off seal assembly shall be gas tight from above and below. Supplier shall indicate the seal element / mechanism and document the corresponding maximum working pressures from above and below.

5.6 Wellhead corrosion cap

For temporary abandonment, a corrosion cap will be installed on wellhead to prevent debris and corrosion.

The following minimum requirements shall apply:

- The WH corrosion cap shall be installed by use of ROV (as base case), drill pipe, or wire.
- The design shall include a visual position indicator to visually confirm that cap is fully landed and locked.
- The corrosion cap shall, after installation, be secured in its latched position
- The corrosion cap shall allow injection of corrosion inhibitor to protect the seal surface contained within the 10 3/4" / 9 5/8" casing hanger, lock down sleeve (if any) and 18 3/4" wellhead housing. The corrosion cap shall include necessary facilities for injection of the inhibitor at the right elevations inside the wellhead housing, independent of the specific gravity of the inhibitor fluid relative to seawater and avoid any risk of damaging sealing area at installation and retrieval. A solution based on pre-installed biocide (bag) prior to running may be acceptable.

5.7 Running tools / Test tools

A list covering all required running tools/test tools to install, retrieve, maintain and operate the subsea wellhead system shall be specified by Contractor.

The following minimum requirements shall apply for the subsea wellhead running tools:

- The running tools shall be designed to allow for safe and efficient offshore installation.
- The casing hanger running tool shall allow for casing hanger and pack off installation in one trip. In the same trip, it should be possible to clean the pack-off seal area prior to setting the pack-off.
- The casing hanger running tools shall either retrieve the pack off in the event that the seal assembly has not been fully set OR have impression pins that give surface verification that seal assembly has been correctly set.
- Wear bushing running tool shall allow the BOP testing in the same run, providing sealing inside the WH HP housing.
- All tool joints shall be designed to allow for minimum one thread cut-off.
- All tools joint shall be designed with a minimum 18" tong neck to ease offshore tool/string make-up or break out. The tong neck shall accept an iron roughneck.
- All running tools shall be rated to accept full string hang-off load and operational / contingency over pull loads.
- The running tools shall interface to the running string with a suitable drill pipe connection based on the expected string weights. Open water tools shall have a connection equivalent to API 6"5/8 Regular minimum (API 6 5/8" minimum pin down is also required below the Drill Ahead Tool). All connections are to be determined based on the expected loads which are be clearly documented in the Tender.

- All resetting and re-dress of wellhead running tools shall be possible to be performed offshore. All required tooling shall be supplied by Contractor and be part of the wellhead running tool inventory offshore.
- All the running and test tools shall be provided with a dedicated handling support in order to fit them in the rotary table for easy make up.
- Contingency tools shall be provided for all phases where emergency equipment is provided, and where available, tooling to rectify the situation. For example; Seal Assembly Retrieval Tool to retrieve failed pack off, Mill and Flush Tool to clean the area before emergency pack off is ran.
- Nylon nose jetting tool shall be provided. This jetting tool is also intended to be ran below running / retrieval tools where there may be a chance of damaging or contacting seal faces within the wellhead system.

5.8 False Rotary and Hang-off Plates

Handling plates or clamps shall be provided to land the LP and HP housings at the rotary table. The plates design shall position the above equipment no higher than 2 feet above the floor.

False rotary table shall be provided to land on top of the above items to facilitate running inner drill pipe cementing string.

5.9 Bore protector and wear bushings

The bore protector and wear bushings shall satisfy the following requirements:

- Protect the inner bore of the wellhead housing and all components of the installed casing hanger and pack off assemblies installed within the wellhead system, as well as protect future potential seal surfaces, during drilling and completion operations.
- Wear bushings shall be designed to withstand all hydraulically imposed end-forces due to BOP testing.
- Permit the BOP isolation test tool to be run and the BOP to be tested without the need to retrieve the bore protector or wear bushing.
- Include a retention system to lock into the wellhead housing to prevent damage and premature release during drilling operations.
- Include a positive mechanical anti-rotation device to prevent any rotation of the wear bushing during installation, retrieval or any phase on the drilling and completion operation.
- Include an adequate sealing system to prevent any debris or trash to enter the seal face area during drilling or completion operations.

5.10 Emergency hang-off tool (optional)

The emergency hang-off tool shall satisfy the following requirements:

- Suspend the complete drill string in the wellhead or on the BOP rams when operating conditions demand.
- Be spaced out to enable all pipe rams to close on the string providing isolation between the annulus and the drill pipe bore and allowing closure of blind rams above the tool box



connection. This may require a rig/BOP specific slick joint. Drill string connections to be specified by the specific project.

- Tapered section on the slick joint below tool joint connection to have extended taper section (i.e. shallow angle) to allow smooth transition to regular outside diameter for stripping purposes.
- Maximum tool joint outside diameter to be 7" to allow stripping through variable rams.
- Allow for string circulation.

5.10.1 Upper donut

Include a lower drill string connection to be specified by the project (maximum outside diameter 7" to allow stripping through variable rams). Include an upper box connection to the handling string running tool. A quick stab/release thread shall be included in design.

Allow for string hang-off on closed BOP pipe rams (i.e. include flat face on lower shoulder).

5.10.2 Lower donut

Provide a landing shoulder allowing for landing on any component in the wellhead (WH housing, bore protector, wear bushing, casing hanger and pack-off).

The hang-off tool shall have a 4-1/2" x IF connection with left hand threads and guide for re-entry.

Provide guidance/alignment during re-entry of the drill pipe handling tool.

5.11 Auxiliary equipment

A list covering all required auxiliary equipment for the subsea wellhead system shall be specified by Contractor.

6. Testing requirements

6.1 Introduction

As the wellhead is a standard product, units and systems shall be tested in accordance with the relevant industry standards: Factory Acceptance Test (FAT), in accordance with [ISO 13628-4](#) and [ISO 10423](#) standard.

Subsea Wellhead System Verification Tests shall be conducted to prove that all the different types of Subsea Wellhead System satisfy all the loads, pressure integrity, installation, retrieval and functional performances listed in the specification.

All documents and procedures shall be submitted to the Company for approval 30 days in advance prior the testing commencement.

6.2 Qualification

The well head system shall be qualified in accordance with [ISO 13628-7](#) and [ISO 10423](#)

6.3 Factory Acceptance Tests (FAT)

Factory Acceptance Tests (FAT) of all Units shall prove that the components of a Unit and the Unit itself satisfy all specified requirements to strength and functional performance.



All tools shall be function tested and interfaced with the installable parts or dummies.

6.4 Wellhead System Verification Test

The purpose of the Wellhead System Verification Test is to prove that all the different types of Subsea Wellhead System satisfy all the loads, pressure integrity, installation, retrieval and functional performances listed in the specification.

As a minimum, the standard wellhead system will be interfaced with all types of PGB proposed by the Supplier.

Unless otherwise agreed with Company, the Wellhead System Verification test shall include stack-up and pressure test of the complete wellhead system using the appropriate running tools using the installation sequence and procedure, which will be used in the field. This testing is compulsory in case of any dimensions, or design changes compared to field proven systems.

7. Test, handling and transportation equipment

Transportation skids shall be provided for all tools.

The transportation skids and baskets shall meet the following requirements:

- The transportation skid shall include sufficient lifting points for safe handling and up righting of a fully loaded skid or basket.
- They shall be suitable for short-term storage of the respective wellhead tools.
- They shall provide a means to prevent the respective wellhead tools from sliding and rolling.
- They shall provide sea fastenings for the rig and transportation vessel.
- All components including transportation basket shall not exceed a weight of 10 Tons.
- Shall accommodate a vessel heel of 35 degrees.
- All lids and protection covers shall be possible to lock in both closed and open positions.
- If multiple tool skids are delivered for transport purposes, general single transport skids should be supplied as back up for transporting one off tool.
- Transportation skids for pre-assembled units (tools + components) should also be a part of the WH delivery.
- Tools and skids shall be designed and marked so that each tool can be easily identified without taking it out of the transport box.

8. Documentation

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.	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 include 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 (*)
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	



Rep.	Documents to be provided	Tender	F.A.T.	Delivery
11	Wellhead Strength and fatigue For each weld ID, weld OD, connector body of the LP conductor string, the unique S-N curve and S.C.F details for misalignment and geometrical variations. The fatigue design life shall be clearly presented based on Location, Environmental Data, Soil Data, Well Architecture and Program, all provided by COMPANY. During Tender phase, Contractor shall present a draft document based on previous studies done for equivalent conditions.	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.

9. Specific manufacturing and inspection requirement

9.1 General

No weld repair is permitted on materials without prior written permission from Company.

Welding Procedure Specifications and Welders Qualifications shall be submitted to Company Materials & Welding Specialist for Approval.

9.2 LP and HP housings

The housing Girth weld shall be ground flush on the OD & ID to improve fatigue rating, this shall be completed PRIOR to NDE. The minimum pipe wall thickness should be maintained and verified following completion of the grinding process.

Where accessible, double 'V' welds shall be applied to all welds associated with the housings to extension joints, and extensions to connectors. Supplier shall confirm where double V welds can be performed.

The housing and connector girth welds on Extension joints shall be subject to the following supplementary NDE (All NDE shall be performed 48hrs after stress relieve heat treatment):

- 100% Radiographic Testing according to SR29
- 100% Ultrasonic Testing per SR36, acceptance per ASME VIII Division 1 UW51
- 100% Magnetic Particle Testing on the inside and outside according to SR30

10. Quality

10.1 Quality Assurance

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



10.2 Quality control

Unless a generic QCP has been agreed with Company Quality Assurance / Quality Control technical authority, 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



Bibliography

GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP SPS 002	Design of subsea structures
GS EP SPS 003	Foundation design considerations for subsea stations