

GENERAL SPECIFICATION

Drilling & Wells

GS EP FP 412

Workover Subsea Completion Systems for Horizontal Tree

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1. Scope

This technical specification is applicable to Workover/Completion systems for all the wells equipped with a Horizontal Christmas Tree. It defines the functional requirements to Workover/Completion equipment with associated control systems and umbilicals required to install the various Units and to perform Workover on Subsea Stations using the same type of drilling unit later on during the field life. The various running tools, such as Tree and Tubing Hanger Running Tools are described within the respective tree system specifications.

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 technical specification is supplementary to document **GS EP SPS 001**, and shall therefore be read in conjunction with said document and the other COMPANY specifications and standards identified therein.

The Workover/Completion System with all individual Units shall comply with all relevant statutory requirements and specifications as well as all relevant ISO, API and other referenced standards, unless otherwise stated by COMPANY.

External Documents

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

Reference	Title
ISO 13628-1	Petroleum and Natural Gas Industries - Design and operation of subsea production systems Part 1, General requirements and recommendations
ISO 13628-4	Petroleum and Natural Gas Industries - Design and operation of subsea production systems - Part 4, Subsea Wellhead and Tree Equipment
ISO 10423	Petroleum and Natural Gas Industries – Drilling and Production Equipment – Wellhead and Christmas Tree Equipment Second Edition
ISO 898	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
NAS1638	Cleanliness Requirements of Parts Used in Hydraulic Systems
NACE MR 0175/ISO 15156	Material Requirements. Sulphide Stress Cracking Resistant, Metallic Material for Oil Field Equipment
ASME BPVC	Boiler and Pressure Vessel Code
SAE AS 4059E	Cleanliness classification for Hydraulic fluids

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Reference	Title
SAE J 517	Hydraulic Hoses
SAE J 343	Test and Procedures for SAE 100R series hydraulic hoses and assemblies
API SPEC 6A	Specification for Wellhead and Xmas Tree Equipment
API SPEC 8C	Drilling and Production Hoisting Equipment
API SPEC 16A	Specification for Drill Through Equipment
API SPEC 16D	Control Systems for Drilling Well Control
API SPEC 17D	Specification for Subsea Wellhead and Xmas Tree Equipment
API SPEC 5CT	Specification for Casing and Tubing
API RP 17G	Recommended Practice for Design and Operation of Completion/Workover Riser Systems
API RP 17H	ROV Interfaces with Subsea Equipment
API RP 16Q	Design and Operation of Marine Drilling Riser System

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP SPS 001	Subsea Production Systems General Design Requirements
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 (Cancelled Document)
GS EP SPS 023	Cleaning and Flushing of Hydraulic Systems
GS EP FP 411	Subsea Horizontal Christmas Tree System

Other equivalent and recognized standards not referenced above may be used if agreed by Company.

3. Introduction

3.1 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, and other relevant standards and statutory requirements. Deviations from any of the requirements defined herein shall be clearly identified and treated as non-conformance in accordance with relevant Company procedures.

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In case of discrepancy between standards and / or specifications, the most stringent shall apply unless otherwise specified by the Company.

3.2 Abbreviations

The following abbreviations are used in the document:

AMV	Annulus Master Valve
AWV	Annulus Wing Valve
BOP	Blowout Preventer
CIV	Chemical Injection Valve
EQD	Emergency Quick Disconnect
ESD	Emergency Shut Down
FAI	Fail As Is
FSC	Fail safe close
HP	High Pressure
HXT	Horizontal Christmas Tree
HPU	Hydraulic Power Unit
ID	Inside Diameter
ITC	Internal Tree Cap
LMRP	Lower Marine Rise Package
LP	Low Pressure
MIV	Methanol Injection Valve
MQC	Multi Quick Connection
NPT	Non Productive Time
OD	Outside Diameter
PCS	Production Control System
PCV	Production Choke Valve
PMV	Production Master Valve
PSD	Production Shut-Down
PWV	Production Wing Valve
RCM	Remote Control Module
ROV	Remote Operated Vehicle
SCM	Subsea Control Module
SCSSV	Sub surface safety valve
SLV	Service Line Valve
SPWV	Surface Production Wing Valve

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SSTT	Sub Sea Test Tree
STT	Surface Test Tree
TCTV	Tree Cap Test Valve
TH	Tubing Hanger
THRT	Tubing Hanger Running Tool
UPS	Uninterrupted Power Supply
WOCS	Workover Control System

3.3 Documents

Documents : [GS EP SPS 019](#), [GS EP SPS 021](#), [GS EP SPS 022](#), [GS EP SPS 023](#), [GS EP FP 411](#), ISO 13628, ISO 10423, ISO 898, NAS 1638, NACE MR-0175 / ISO 15156, ASME, SAE , S , 4059 E, SAE J 517, SAE J 343, API SPEC 6A, API SPEC 8C, API SPEC 16A, API SPEC 16D, API SPEC 17D, API SPEC 5 CT, API RP 17G, API RP 17H, API RP 16 Q are an integral part of this document.

4. System Description

4.1 Workover/Completion (WO/C) system overview

The Workover/Completion (WO/C) system comprises all equipment and associated control systems required to install the various units.

The WO/C systems shall be configured to cover the following main modes of operation:

- Initial completion installation (TH + completion string) and well clean up
- Installation or retrieval of the ITC with the completion riser with or without SSTT
- Installation or retrieval of the ITC with the drill pipe string
- Installation or retrieval of the Horizontal Christmas Tree with drill pipe string
- Major workover on same wells later on during the field life using the same type of drilling rig, BOP and riser.

The Workover/Completion systems covered by this specification, typically comprise the following main Units:

- Slick joint
- Subsea Test Tree (SSTT)
- Shear sub
- Retainer Valve
- Riser Joints
- Lubricator Valves (2)
- Landing joint
- Riser sealing mandrel

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- Surface Test Tree (STT)
- Kelly cock assembly
- Spider, Handling and Make-up Tools

5. Workover/Completion running string systems

5.1 Introduction

The following sections define the requirements for all Units comprising Workover/Completion systems for Horizontal Christmas Trees. The different modes of operation with overall functional and operational requirements together with the corresponding well control requirements are defined.

5.2 Overall functional and operational requirements

The WO/C string shall be configured to cover all modes of operation stipulated in section 4, System Description.

The WO/C string shall include the necessary equipment and functionality to allow safe and efficient performance of the operations.

The WO/C string shall provide a pressure containing conduit for well bore fluids and smooth passage of the necessary well bore tools and equipment between the tubing hanger or ITC and the surface vessel.

The WO/C string shall be designed to facilitate all operations required to install/retrieve the TH, the ITC, the TH Production bore isolation sleeve, the TH and ITC protection sleeve and associated running tools for plugs/sleeves.

The WO/C string shall include, as a minimum, a valve configuration as follow to provide safe well control.

Valve	Failure Mode
2 Lubricator Valves (LV)	FAI
Retainer Valve (RV)	FSC
SSTT Upper Valve (SSTTUV)	FSC
SSTT Lower Valve (SSTTLV)	FSC

A nitrogen injection sub and / or chemical injection sub may be required.

The WO/C string shall include the following main equipment:

1. A slick joint below the SSTT, connected to the THRT, to allow isolation of the annulus using BOP rams.
2. A SSTT with the necessary valves to allow safe isolation of the well bore even with wireline or coiled tubing or braided coiled tubing in the well.

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3. A quick disconnect point above the SSTT, allowing for disconnection/re-connection of the riser string with independent primary and secondary methods for disconnection.
4. A shear sub designed to enable cutting of the running string above the SSTT and SSTT disconnection point, with a BOP shear ram in the event of failure of both primary and secondary disconnect systems. It shall be designed to be shearable with the type of BOP mentioned in Drilling rig specification.
5. A Subsea retainer valve to isolate the riser at the bottom end in the event of a disconnection in order to prevent fluid from the well bore to enter into the marine riser and pollution to the environment.
6. A transition joint to provide a link between the lower tools and the riser control module.
7. A riser control module to perform the completion/workover functions through an electro-hydraulic multiplex control system (project specific).
8. A monobore riser with the necessary umbilical clamped on it.
9. Two subsea lubricator valves to provide pressure containment close to the surface for deployment of wireline tool strings.
10. A Kelly Cock Assembly for connection to the riser at any time during running/retrieving of the landing string.
11. A swivel and a Surface Test Tree (STT) with the necessary functions to allow isolation of the well bore and access for wireline and coiled tubing.

All hydraulic and electric functions running inside the drilling riser and BOP shall be controlled from the WOCS.

The equipment provided shall allow for installing or retrieving the ITC using WO/C riser with or without the SSTT.

Two options shall be proposed for the monobore riser:

- Monobore riser used only with the marine riser and BOP package. Riser joints could be in this case made of tubing (or casing) joints with premium threads.
- Riser joints designed for "open sea operations" and to be run inside the marine riser and BOP package.

The final choice shall be Project Group decision. Contractual aspect and economics shall be part of the decision.

5.3 General functional and design requirements for the WO/C running string

The following general functional and design requirements are applicable to the entire Workover/Completion String or the relevant parts of it:

1. The entire Workover/Completion String shall be capable of supporting the full weight of the tubing hanger system and the production tubing string, and shall have adequate strength to allow retrieval of the tubing string with sufficient force to overcome total string weight and maximum expected downhole friction + 50 metric tons. Minimum load capacity shall be homogeneous with the TH requirement (see Tubing hanger system/general requirements).
2. All equipment shall be rated to 10000 psi working pressure unless higher pressure rating is required.

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3. All equipment shall withstand external hydrostatic pressure with atmospheric pressure inside.
4. The WO/C string shall be designed to be deployed through an 18"3/4 ID BOP system and marine drilling riser.
5. The Sub Sea Test Tree (SSTT) shall be designed to facilitate well control and safe re-entry in the event of an emergency disconnection, even with wireline or coiled tubing or braided coiled tubing in the well, and isolate the well bore.
6. The STT shall be designed to allow communication with the well bore, through surface valve control. It shall allow work over operations inside the wells, by deployment of wireline or coiled tubing through the top of the STT.
7. The entire WO/C string and its components shall be designed to allow unhindered passage of all components required to perform well intervention and to establish the necessary well barriers, including wireline and coiled tubing tool strings.
8. All valves in the vertical bores shall be designed to allow snag free operation of wireline and coiled tubing equipment through the valves, and shall include facilities to ensure correct alignment of the valve bores relative to the bore of the landing string. The valve bore closing elements shall have beveled edges to reduce the risk of snagging.
9. The components of the WO/C strings shall be designed to tolerate the most severe combinations of coincidental loads from internal and external pressures, temperatures, compression from the BOP rams/annular preventers, and axial riser loads for all conditions during handling, transportation, as well as normal operations and contingency operations.
10. Riser systems and umbilicals shall be analyzed, designed and qualified for the requested design and operating conditions. Calculation modes shall be agreed by Company.
11. The riser components including the lubricator valves shall be designed with beveled profiles for snag free running inside a marine drilling riser, with the umbilical bundles required to operate the landing string functions, attached to it.
12. All components of the WO/C string (including the TH with THRT) shall be designed to be run through a standard 18-3/4" BOP stack with marine riser and flex joint, and shall be capable of snag free passage with the flex joint deflected to an angle of 3°.
13. The THRT and lower landing string including the adapter above the retainer valve shall be designed for assembly/disassembly on land and transportation offshore as one unit.

5.4 Workover/Completion Units

5.4.1 Slick joint

The slick joint shall provide:

A slick section for isolation of the annulus with BOP rams, and be designed in such a way it permits to apply pressure test on TH seals.

A lower connection to the Tubing Hanger Running Tool, and a upper connection to the SSTT.

The slick joint shall consist of 10 3/4" OD pipe section with integrated control lines for the THRT and TH functions.

For a correct spacing out inside the BOP stack, the slick joint length complies with: