



Exploration & Production

GENERAL SPECIFICATION

SUBSEA SYSTEMS

GS SPS 007

Tie-in systems

01	08/03	Change of Group name and logo
00	10/02	First issue
Rev.	Date	Notes



Contents

1. Scope	3
2. Reference documents.....	3
3. Introduction	5
3.1 Terms and Abbreviations	5
3.2 Responsibility.....	5
4. Design philosophy	6
4.1 General.....	6
4.2 Materials and corrosion protection	7
4.3 Flow assurance.....	7
4.4 Abandonment	7
5. Tie-in system requirements.....	7
5.1 General.....	7
5.2 Pull-in and Connection Tool	8
5.3 Connectors and seals	9
5.4 Hubs and terminations	10
5.5 Jumpers/Spools	10
5.6 Caps/pig launchers	10
5.7 ROV tools	10
5.8 Tie-in Porches and alignment structures	10
5.9 Operations	10
5.10 Design report	11
6. Interfaces	11
7. Qualification testing.....	12



1. Scope

This specification is mainly based on the [ISO 13628](#) « Petroleum and natural gas industries - Design and operation of Subsea Production Systems ».

The purpose of this document is to specify the minimum additional requirements and amendments thereof for the design, fabrication, installation, testing, commissioning, operation and abandonment of the Subsea Tie-in Systems for Subsea Production Systems.

This specification is complementary to [GS SPS 001](#) and [GS SPS 002](#).

The Tie-in System encompasses Pull In and Connection equipment and tools for the Tie-in of rigid and flexible lines and spools as well as the Tie-in of umbilicals.

The specification covers both permanently installed equipment and associated tools and temporary equipment required for offshore installation and commissioning of the systems as well as potential intervention work.

This specification is valid for diverless Tie-in systems.

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 the reference documents reported section 1 and shall therefore be used in conjunction with these said documents; in the event of any conflicts between the provisions of the reference documents, the following order of priority shall apply:

- COMPANY specifications
- Main International reference documents, with the following order of priority:
 1. [ISO 13628](#), as the baseline for Tie-in systems design, installation and operation requirements, particularly section 1, 2, 5, 6, 8 and 9.
 2. API, which should be used for specific material and components selection.
 3. Others standards upon COMPANY approval, wherever a specific item is not covered by the above documents.

Standards

The latest edition of the following industry standards, including amendments at the time of order placement and other referenced standards and codes, shall apply unless otherwise specifically agreed.

Reference	Title
ISO	ISO 13628, as the baseline for Tie-in systems design, installation and operation requirements, particularly section 1, 2, 5, 6, 8 and 9
ANSI	ASME Boiler and Pressure Vessel code section III - Rules for Construction of Nuclear Power Plant Components
ANSI B 16.5	Pipe Flanges and Flanged Fittings
ANSI B 31.4	Liquid Transportation Systems for Hydrocarbons



Reference	Title
ANSI B 31.8	Gas transmission and distribution piping system
ANSI B 31.3	Chemical plant and Petroleum refinery piping
NACE MR 0175	Material Requirements - Sulphide Stress Cracking Resistant Metallic Material for Oil Field Equipment
API	Rules and Recommended Practices as listed in ISO 13628 part 1 - Bibliography (p. 128) - In addition API RP 17D
DNV	- Rules for submarine pipeline and offshore riser systems - Certification note 2.7-1: Offshore Freight Containers - RMO: Rules for planning and execution of Marine Operations
Others	Equivalent recognised standards not referenced above may be used upon COMPANY agreement.

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS COR 102	Design of cathodic protection of sealines by sacrificial anodes
GS COR 401	Installation of anodes on submerged pipelines
GS COR 502	Control by electrical measurements of cathodic protection of submerged pipelines

Reference	Title
GS PLR 205	Steel pipe for pipelines
GS PLR 222	Carbon steel flanges for pipelines (sweet effluent)
GS PLR 231	Induction bends for pipelines (sour effluent)
GS PLR 232	Carbon steel flanges and branch outlet fittings for pipelines (sour effluent)
GS PLR 401	Installation of submarine pipelines
GS PLR 420	Site welding of carbon steel pipelines to API 1104 (sweet effluent)
GS PLR 421	Site welding of carbon steel pipelines to API 1104 (sour effluent)
GS PVV 614	Welding of duplex and superduplex stainless steel pipework
GS SPS 001	Design Philosophy and Requirements for Subsea Stations
GS SPS 002	Design of Subsea Structures
GS SPS 008	Thermal Insulation of Subsea Stations
GS SPS 009	Corrosion Protection of Subsea equipment
GS SPS 023	Cleaning and Flushing of Hydraulic Systems

3. Introduction

3.1 Terms and Abbreviations

The following abbreviations and terms are used in this specification:

API	American Petroleum Institute
ISO	International Standardisation Organisation
OBSROV	Observation Remote Operated Vehicle
WOROV	Work-class Remote Operated Vehicle
ROT	Remote Operated Tool
Line system	Mono-bore or multi-bore system comprising flexible line(s), rigid spool(s), pipeline(s) and umbilical(s)
Host structure/Facility	Structure or facility to which a given Tie-in system is dedicated

3.2 Responsibility

Deviations from any of the requirements defined herein shall be treated as non-conformances in accordance with COMPANY procedures.

It is the responsibility of anyone who supplies structures, intervention means and equipment according to this specification to ensure compliance with all relevant statutory requirements.

4. Design philosophy

4.1 General

Tie-in systems shall be designed for diverless and guidelineless installation and interventions. For shallow water applications an exemption to this rule can be considered.

Tie Ins system shall be designed in conjunction with the flow line retained concept.

The tool shall be a combined tool capable of doing both pull-in and connection operation in one run if pull-in is required.

Contingency procedures and means shall be developed for installation, field operation and abandonment phases.

The following major types of tools are acceptable.

- ROV carried tools, powered and controlled by an ROV:
 - Launched and retrieved with the ROV, or
 - Launched separately to the seabed where the ROV docks onto the tool and swims it into position, or
 - Launched directly into position without guidewires and where the ROV only provides power and control.
- ROT tools with a dedicated remote control system
- Any other solution to be submitted to COMPANY.

Installation methods shall be selected after assessment of combined risk and benefit analysis, the aim being to select the most appropriate connection methods amongst the following ones (ref. [ISO 13628](#) part 1 - A8.5 - "End Connection"):

- Spool piece method
- Pull-in method
- Stab-in and Hinge-Over method
- Direct lay away method
- Deflect-to-connect method
- Direct vertical connection method
- Other methods may be proposed to COMPANY for approval.

The design shall be based on field proven efficient and reliable solutions. However attractive but non-field proven alternatives for the Project may be proposed for COMPANY acceptance. A corresponding qualification program shall be developed and executed by CONTRACTOR in such a case.

Design shall be based on an adequate combination of WORO and ROT, operable from all types of vessels (monohull, RIG, etc.). The number of ROVs required for successful Tie-in operations shall be minimised. Requirement for observation ROV (OBSROV) shall be avoided. The design of the Tie-in system shall be presented with the corresponding sketches and operational procedures to demonstrate the effectiveness and the adequacy of the recommended solution.

The selection of the Tie-in system shall be based on:

- Identification and screening of potential solutions
- Comparative analysis of identified solutions from a technical, operational, cost viewpoint
- Suitability to Project local conditions and adequacy with flowline and umbilical designs
- Experience feed back from previous installations.

4.2 Materials and corrosion protection

Reference is made to **GS SPS 009** for external protection and **GS SPS 001** for internal protection.

Steel and non-steel materials used in the Tie-in system shall have dedicated protection systems against external and internal corrosion.

4.3 Flow assurance

Reference is made to **GS SPS 008**.

The overall thermal losses of the Line system shall lie within an acceptable range and the cool down periods shall remain acceptable, unless cold point management measures can be implemented in a reliable way.

4.4 Abandonment

Reference is made to **GS SPS 001**.

5. Tie-in system requirements

5.1 General

The pull-in and connection system shall have:

- Simple and compact design
- Simple control system
- Minimum structures and equipment to be left subsea
- No active components, e.g. hydraulic or electric shall be left subsea.

Design shall be driven by cost/time efficient cycle (manufacture, installation/retrieval operations, etc.).

All parts of the system shall be designed for the maximum loads imposed during pull-in, connection and production operations.

Tie-in systems and their components shall at least have the same mechanical resistance and lifetime as of the line pipes they are connected to.

Pressure levels to be considered for the design of Tie-in systems shall at least comply with the pressure levels considered for the design of the Line system.

The design of the host structures shall facilitate the Tie-in operation during installation and intervention. The design may incorporate following specific equipment such as but not limited to:

- Guiding devices such as posts, cones, ramps, etc.
- Specific marking as defined in [ISO 13628](#) - Part 1 - Annex B.

The Tie-in system and its components shall not affect the use of the selected standard pigging tools, either for cleaning, calibrating or internal inspection of the Line system it relates to.

CONTRACTOR shall identify per type of operation (equipment launching and running, positioning, connection and testing) the operational limitations of subsea and surface work (environment, simultaneous works, simultaneous production operations)

The nominal deployment and connection conditions and their acceptable limits of variation shall be assessed with due consideration of the quasi-static and dynamic effects induced by:

- Surface support vessel
- Installation tools and equipment
- Sea conditions (waves, current profiles)

with respect to the operational sequences.

The design and the operational procedures shall demonstrate that the final step of the descent and the landing operations can be carried out in a fully controlled manner.

The design principles and requirements set in this specification are also applicable for any temporary components that can be needed in a phased field development (e.g. temporary blank spools).

5.2 Pull-in and Connection Tool

The selected ROT and associated intervention procedures shall fulfil [ISO 13628-9](#) requirements and any deviation or alternative thereof shall be fully documented for submission to Project review and approval.

The tool shall be mechanically locked to the subsea structure or alternatively to the termination during the pull-in and connection operation. It shall be possible to verify that the tool is safely locked in position.

The tool shall be designed such that it can be launched, landed, operated and retrieved from a monohull type vessel or from drilling rig.

The maximum acceptable landing velocity and acceleration of the subsea intervention tools dedicated to the Tie-in systems shall be fully assessed.

The tool shall have a soft landing device allowing landing velocity of minimum 1.5 m/s.

Heave compensated winches shall be avoided.

If a heave compensated winch is required for any particular documented reason, it shall be clearly demonstrated that it will not affect the safety, reliability and the efficiency of the ROT operation.

A back-up procedure shall be available in case of heave compensation system failure.

Contingency procedures and back up systems shall be available for all realistic failures of the equipment. Equipment failures shall not impact the safety of surface vessel and personnel



onboard. The system design shall minimise the risk of damage to the subsea lines or structures, resulting from equipment failure.

In case of control system failure, power failure or mechanical failure, the tool shall be retrievable by means of a back-up system i.e. ROV override of locking mechanism, etc. Pad eyes for emergency lifting shall be included.

Contingency procedures not backed up by field intervention documentation, shall be subject to a shallow water validation program.

Contingency procedures shall be fully documented (operations report, local conditions).

All operations shall be fully reversible.

It shall be possible to perform disconnection with the same tool as used for connection.

The pull-in winch shall be incorporated in the tool and the wire/rope shall be of non-twisting type.

Pull-in shall be possible with or without backtension. Maximum pull-in force and pull-in angles shall be established. The horizontal and vertical alignment capacity of the tool shall be assessed and verified by testing.

The need and structural consequences of a pull-in back-tension shall be fully assessed.

The intervention tools shall be equipped so that for any operation, the critical operating parameters can be monitored and will remain within the specified operating envelopes.

It shall be possible to monitor the pull-in force at any time during pull-in.

The tool shall incorporate means for testing the connection by an external seal test after a connection is made up. Alternatively, this operation might be performed by a separate ROV tool.

5.3 Connectors and seals

Metal-to-metal seals shall be used.

The seal materials shall be compatible with the injected and produced fluids.

The sealing surface on the hub shall be harder than the seal material. Material resilience of the seal and sealing surfaces shall be in line with **GS SPS 001** and shall take into account the local project condition.

The connector and seals shall be replaceable without taking the hub to the surface.

Make-up or breakout of connector at misaligned conditions shall not transfer any detrimental loads or displacements into the tool, the hubs or the connector.

The bending moment capacity of the connections shall as a minimum be equal to that of the pipe.

The connector shall permit repeatable connections and disconnections during the field life. The minimum number of connections/disconnections to be considered for design is one per year per connection system.

It shall be possible to perform seal and hub seal surface inspection and cleaning prior to the connection.

Connections shall incorporate access ports for external seal tests that shall be performed with subsea intervention means.

Waterlock issues shall also be addressed through an adequate specific study.

5.4 Hubs and terminations

The sealing surface on the hub shall be harder than the material of the seal.

Hubs and seals shall not represent a flow restriction and shall have flush inner diameter for pigging purposes.

The hub seal surface shall in case of damage accommodate contingency seal surface by installation of modified seals.

Hydraulic lines should include check valves to prevent loss of hydraulic fluid or ingress of water and dirt when disconnected.

Multibore connections shall have a system for orientating the outboard hub and seal assembly relative to the inboard hub.

The termination head on single bore lines shall have a swivel arrangement to allow rotation of the line during pull-in.

5.5 Jumpers/Spools

Reference is made to **GS SPS 002**.

5.6 Caps/pig launchers

The following types of caps shall be available for the hubs:

- Protection cap for protection of the hub against dirt and mechanical damage
- Pressure cap to withstand external pressure during installation of sealine or structure. A pressure equalisation device shall be included
- Pressure cap for pressure testing of the sealine or structure pipes. This should include both a blind cap and a test/blind cap with possibilities to pressurise or fill through the cap.

All caps shall be easily installable and subsea retrievable.

Pressure caps shall be rated for the Project specific water depth and system pressure.

When subsea pig launchers are required, they shall be subsea installable and retrievable.

5.7 ROV tools

All ROV tools shall be designed for use on a standard WROV with respect to weight and handling.

Tools for cleaning and inspection of seal surfaces shall be available. Tools may be built in pull-in and connection tool or be a separate ROV tool. Cleaning tools shall provide capability to inject acid fluids.

5.8 Tie-in Porches and alignment structures

The pull-in porches shall support and align the tool during the Tie-in operations.

5.9 Operations

The sequence of Tie-in operations shall be clearly established and fully documented.

All steps of operation shall be fully reversible without affecting the integrity, reliability safety of the Tie-in system.

In the event of both deficient visual access and positioning systems, alignment, docking and final connection shall not be performed until full recovery of the visual access and positioning functionality.

Assessment of the Tie-in system principles shall be done with an appropriate combination of computer numerical analysis and 3 D static/dynamic modelling

Temporary monitoring and back-up systems shall be available in order to make sure that the intervention means are safely and fully locked or unlocked on the host facilities.

Back-up and recovery procedures shall be fully documented.

5.10 Design report

The engineering file system shall incorporate a design report supplemented with its detailed appendices (calculation notes, drawings, SUPPLIERS' documentation, etc.). The design report shall cover as a minimum the following sections:

- List of Tie In options screened
- Conclusions and recommendations (design, fabrication, installation, interventions, field operations, etc.)
- Consistency review of the applicable normative references
- Review of the design basis ([ISO 13628](#) - Part 1 - informative annex F)
- Summary data sheets
- Internal and external design pressure
- System limitations
- Risk analysis and mitigation measures
- SUPPLIER's documentation for the components of the selected Tie-in systems
- Manufacture and installation reports
- Operation and maintenance manual
- Contingency repair plan
- Abandonment plan.

6. Interfaces

The identification and management of interfaces are set by the Project Interface Specifications. CONTRACTOR will be involved in a number of interfaces. A non-exhaustive list of major interfaces is as follows:

- Flow lines to template/manifold connections (for production and injection line)
- X-Mas Tree to manifold connection for an on and off template wells
- Single well to production or injection lines
- Control umbilicals to template/manifold connections
- Control jumper to X-Mas Tree connections.



CONTRACTOR shall supply and obtain the required information to and from other CONTRACTOR involved in the Project.

CONTRACTOR shall ensure coherence between the Tie-in system and the flowlines system particularly in the areas of:

- Installation methods and means
- Pull-in requirements
- Connector requirements (mono bore or multibore)
- Pigging philosophy
- Sequence of offshore operation
- Simultaneous operations.

7. Qualification testing

Reference is made to **GS SPS 001** section 8.

The principles developed in the above document apply for permanent subsea equipment and for the installation/intervention tools and equipment of the Tie-in system.

All new Units and parts thereof, shall be qualified in accordance with the requirements of relevant ISO standards, API specifications, and COMPANY specifications.

New Systems, comprising qualified Units in combinations or configurations without previous field history, or a verification record, shall be verified by testing as above.

Modifications on a previously qualified product, which in COMPANY's opinion affects the performance of the product in the specified service conditions, shall undergo a new qualification test.

Operational procedures and equipment/tools without sufficient track record in conditions similar to the Project shall undergo a qualification program.