



Exploration & Production

## GENERAL SPECIFICATION

### SUBSEA SYSTEMS

#### GS SPS 015

**Subsea gate valves and actuators  
in subsea Xmas-tree systems**

|      |       |                               |
|------|-------|-------------------------------|
|      |       |                               |
|      |       |                               |
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## 1. Scope

The purpose of this specification is to define the functional and design requirements to gate valves and actuators in subsea X-Mas Tree Systems. This specification covers both ROV operated valves and hydraulically operated valves with ROV override and is applicable for all gate valves in the X-Mas Tree System exposed to well fluids.

## 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 complementary to document **GS SPS 001**, and shall therefore be read in conjunction with said document and the other COMPANY specifications and standards identified therein.

The valves shall comply with all relevant statutory requirements and specifications as well as all relevant ISO and other referenced standards, unless otherwise stated by COMPANY.

### Standards

| Reference         | Title                                                                    |
|-------------------|--------------------------------------------------------------------------|
| ANSI B 16.5       | Pipe flanges and flanged fittings                                        |
| ASME/ANSI B 16.34 | Valves - Flanged, Threaded, and Welding End                              |
| ASME              | Boiler and Pressure Vessel Code Section V - Non Destructive Examination  |
| ISO 10423         | Drilling and Production Equipment, Wellhead and Christmas Tree Equipment |
| NAS 1638          | National Aerospace Standard for flushing and cleaning                    |
| API 6A            | Specification for Wellhead and Christmas Tree Equipment                  |
| API 17 D          | Specification for Subsea Wellhead and Christmas Tree Equipment           |

### 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 SPS 001 | Design Philosophy and Requirements for Subsea Systems |
| GS SPS 014 | Drill Through Horizontal Tree Systems                 |
| GS SPS 019 | Subsea Production Control Systems                     |

## 3. Introduction

### 3.1 Responsibility

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 identified and treated as a non-conformance.

### 3.2 Abbreviations

The following abbreviations are used in the document:

|      |                             |
|------|-----------------------------|
| HPU  | Hydraulic Power Unit        |
| HXT  | Horizontal X-Mas Tree       |
| ICS  | Intervention Control System |
| ROV  | Remote Operated Vehicle     |
| WH   | Wellhead                    |
| WOCS | Workover Control System     |

## 4. System description

The valve assemblies covered by this specification consists of the following main components:

- Valve assembly
- ROV Interface facility.

The valve assembly consists of:

- Valve body (self contained body or block integral)
- Valve Stem w/Actuator (Hydraulic or manual ROV).

The valve assembly may be used in the following applications/configurations:

- Self contained with bonnets for in-line mounting in piping/flow loops
- Self contained with bonnets where one side is mounted directly onto the valve block (such as X-Mas tree and similar)
- Block integral for use as isolation valve in bore drillings.

## 5. Valve assembly

All valve assemblies shall be designed for the actual specific Dalia field conditions defined for each individual project. The design shall be identified by design life, external and internal design pressures and temperatures as well as material compatibility with produced medium, other well fluids, injected chemicals such as methanol, inhibitors and other relevant chemical substances relevant for each specific project.

### 5.1 Design requirements

The valve design shall meet the following general requirements:

1. Gate valves shall seal against flow in both directions for both low (150 psi) and full working pressure differential for both liquid and gas.
2. The design of the valves shall be in accordance with the requirements defined in this specification, the referred design code [ISO 10423](#) and [API 6A](#), PSL 3.
3. The valve shall be metal sealing between the bonnet and the body.
4. The valves shall be designed for 20 years operation. As the horizontal tree concept is based on the fact that the tree will remain in place even for work over, a special care shall be applied on the valve reliability.
5. All valves shall be full bore design.
6. The valve shall be designed with due consideration to erosion and corrosion, and damage or blocking caused by possible sand or other particle deposition or hydrate formation. For gate valves, special consideration shall be given to the possibility for sand accumulation or hydrate formation in valve cavity.
7. Valve performance shall not be affected by any combinations of operational and design loads acting on it. Performance limitations shall be identified.
8. The valve shall be fitted with ROV override.
9. The ROV override tool shall break open the valve safely and reliably at max. valve differential pressure.
10. The valve stem and end stops shall be capable of accommodating the full actuator thrust and ROV override input torque/force across the entire opening and closing cycle.
11. The weakest point of the valve actuation system shall be outside the stem seal area.

12. For torque calculations, the friction factor between hard face surfaces between seats and gate shall be 0,2 or higher, unless otherwise documented and agreed.
13. Sensitive components such as position indicator arrangements close to the ROV receptacle shall be protected against ROV impact corresponding to 1000 kg at 0,5 m/s.
14. The valve shall be designed and tested to tolerate a bending moment of minimum 3000 Nm and an axial force of 3000 N at the ROV interface without exceeding the specified maximum torque values.
15. Pressure in the cavity shall act in the valve closing direction.
16. The valves and actuators shall satisfy the [API 17 D](#) depth rating criteria at extreme condition of atmospheric cavity pressure and specified water depth.

## 5.2 Sealing requirements

The sealing requirements are:

1. Body/Bonnet seals shall be bi-directional metal to metal. It will be acceptable to use non metallic seal ring in the seat to assist in obtaining low pressure test. The SUPPLIER shall be able to demonstrate the low pressure philosophy.
2. Any floating seat ring shall be single piece with simple piston effect.
3. The stem seal shall as a minimum consist of two separate sealing systems. When specified for a particular field application, one system shall be metal-to-metal seal with pre-tensioning as the main sealing force. Consequently, a metal to metal seal design shall be available and fully qualified for field application.
4. Seats shall be preloaded to provide a contact load in order to limit ingress of debris and to achieve low pressure stability.
5. Non metallic stem seals shall be made of PTFE, PEEK or similar materials, unless otherwise documented and agreed. For valves with rising stem the non metallic seals shall be protected from fluid contamination. The non metallic seals shall have demonstrated their compatibility with the fluids in contact, either by previous field experience or by extended compatibility tests.
6. The stem arrangement shall be fitted with back seat facilities with the stem in upper/withdrawn position.
7. Stem seal leakage shall be vented to ambient atmosphere without causing any pressurising of actuator housing. A bleed port with a check valve shall be fitted to prevent sea water intrusion into the stem housing.
8. The stem seal shall be designed to prevent ingress of sea water at the design water depth with no pressure in the valve cavity.

## 5.3 External connections/Body penetrations

Penetrations in valve body and bonnet shall be avoided. Any ports used for flushing and testing, shall be plugged and seal welded after use.

Vent and drain valves/ports shall be provided as required at the highest possible and at the lowest possible position of the valve, respectively.

## 6. Actuator

### 6.1 General requirements

The following general requirements are:

1. The actuator shall be single acting, hydraulic operated with spring return for "fail safe close".
2. The actuator shall satisfy the [API 17 D](#) depth rating criteria at extreme condition of atmospheric cavity pressure and specified water depth.
3. The actuator shall be designed to overcome max. anticipated force in the valve assuming a minimum gate friction coefficient of 0,2.
4. The springs shall be designed with a cycle fatigue life of minimum 5000 cycles verified by cycle testing.
5. The hydraulic actuator shall have visual position indicator showing full travel, to be observed from the ROV in docked position.
6. The hydraulic cylinders and lines shall be delivered with verified cleanliness level [NAS 1638](#) class 6.
7. The hydraulic piston rod seal arrangement against pressure source shall have double PTFE/PEEK or other non elastomeric lip seal with spring preload. Minimum one lip seal of the same design shall prevent ingress of fluid in reverse direction.
8. The hydraulic piston seals shall be arranged as for "double acting" piston seal.
9. The hydraulic cylinders shall have two independent flushing ports in each chamber (open and return). The ports shall be positioned to ensure 100% filling of the spring chamber. Proper filling shall be verified.
10. The closing side of each hydraulic valve actuator shall be connected to a compensating device. The compensator shall ensure that the closing side of the actuator is exposed to (near) ambient seawater pressure and that the spring and other actuator internal components are enclosed by the approved (corrosion and microbial growth resistant) hydraulic fluid. The compensator hydraulic circuit shall be equipped with a low pressure check valve (around 50 psi) designed to vent excess control fluid which might be forced into the compensator system. The compensator hydraulic circuit shall also be equipped with a low pressure check valve (around 25 psi) designed to draw sea water.

### 6.2 Functional requirements

The following functional requirements shall be implemented in the design:

1. The hydraulic distribution shall be hard piped. Compression rings shall not be used. Tube joints prepared for butt weld connection shall be used.
2. The hydraulic piston seal arrangement shall be designed to withstand peak pressure when overriding the valve against blocked bypass in the hydraulic system.
3. The valve shall have visual position indicator showing full travel in both hydraulic and in override mode.

4. The valve actuator shall have hydraulic (linear override) or mechanical override performed by ROV torque tool. Minimum requirement for tool and actuator.

#### 6.2.1 Hydraulic (Linear) override

- Linear override shall be performed by utilising an ROV carried jacking tool.
- The valve override tool shall be able to hold the valve open under maximum load conditions.
- Rising stem end exposed to sea water shall be insulated from the cathodic protection system either by using a ceramic coating or by insulating the rising stem from rest of the actuator.
- The tool shall be light weight for easy ROV operation.
- Position indicators clearly marking Open/Shut of the valve and Lock/Unlock position for the tool shall be included.
- It shall be possible to mechanically lock the tool to the valve.
- Hydraulic hoses with hot stab for connection to TRT/BOP/ROV etc. shall be included.
- An hot stab parking receptacle shall be included on the tool.
- An isolation valve to lock in hydraulic pressure (to hold tool in extended position) shall be included.

#### 6.2.2 Mechanical override

- Mechanical override spindle shall rotate clockwise to close, counter clockwise to open.
- The required break out torque shall be 30% below the torque tool capacity.
- The stem drive mechanism shall be designed for a torque/thrust force 2,5 times higher than the estimated torque to operate a new valve with full differential pressure under the most severe load condition.
- The actuator or ROV torque tool interface should have a capacity of 2 times the same torque/thrust force at max. actuator hydraulic pressure.

## 7. Material requirements

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

## 8. FAT

### 8.1 Test program

Factory acceptance testing of the valves shall be conducted in accordance with **GS SPS 001** and **GS SPS 014**. The acceptance criteria for hydrostatic and gas test are:

- External test: No leakage
- Internal test: No leakage
- Hydraulic Cylinders: No leakage

In addition to the requirements defined by the relevant standards, the valves shall undergo the following tests and verifications:

- Functional test to verify design requirements shall include measurement and recording of torque values required for opening and closing sequences. The torques required to open the valve with maximum differential pressure and close it with maximum operating pressure shall be recorded.
- Functional test to verify the actuator back pressure meets/exceeds the [API 17 D](#) requirements for the given depth rating. This shall be verified a minimum of 3 times.
- Verify correct interface with ROV manipulator/tool as required.
- Verify correct function of stem system with end stops, position indicators etc.
- Verify number of turns to operate valve from fully open to fully closed position.
- Application of full rated torque at extremes of valve travel.
- Test of the valve shall be performed without grease in cavity and use of other lubricants between gate and seats.
- For valves with inherently “upstream seal”, all efforts shall be made to prove the downstream seals on test on each occasions. Inability to achieve this in production shall result in additional test of each seal.

## 9. Qualification testing

### 9.1 General

New valve designs shall be qualified in accordance with [GS SPS 001](#), and the program for prototype qualification testing defined in [API 6A](#), PR2 performance testing with a realistic temperature gradient through the valve (warm inside - cold outside). API scaling is not accepted for new designs.

All valves shall be sand slurry tested according to [ISO 10433](#) Class 2.

**Note:** Changes in material on qualified equipment shall be clearly indicated and may require valves to be re-qualified.

In addition to the requirements defined in the relevant industry standards, the following requirements shall be fulfilled:

1. The operational torque at normal operation pressure and design differential pressure shall be recorded. All moving parts shall be completely free from lubrication oils etc. The test shall verify torque for operation of valves at zero and maximum differential pressure by cycling of the valve under max./min load conditions with measurement of actuator pressure/torque to verify/record performance (Min. 10 cycles at each pressure level).
2. A life endurance test of minimum 1200 cycles shall be performed.
3. Testing in hyperbaric chamber is required for valves, seals or other components whose operation may be affected by external pressure, and have not previously been qualified or proven in service. Actual conditions shall be sufficiently simulated.
4. Where the design includes more than one seal, each seal shall be proven by individual tests.



5. Stepwise seal tests shall be performed to demonstrate that the valve seals adequately with moderate pressure increments and at all pressure levels.
6. The qualification tests shall demonstrate that galling does not occur.
7. Special attention shall be given to high temperature applications where the relative expansion/contractions of the valve internals/body is of concern. This applies to gate and valve block.
8. Resistance measurements shall be performed to verify electrical continuity between components to be connected to the cathodic protection system. Valve stem, valve closing element, and other relevant parts of the valve internals shall be included in the cathodic protection system.
9. Number of turns to operate mechanical ROV override from fully closed shall be verified. Where drive interface units and/or position indicator units are employed, these shall be included in the tests to confirm these are suitable for the applied loads and that they do not limit the valve stroke.

## 10. Coating and marking

### 10.1 Coating

The coating system shall be as per **GS SPS 009**.

For high temperature applications, outside “skin” temperature shall be determined and if necessary, a fully proven high temperature coating system shall be used.

### 10.2 Marking

As per **GS SPS 001**.

## 11. Mechanical completion and preservation

As per **GS SPS 001**.