



Exploration & Production

GENERAL SPECIFICATION

SAFETY

GS EP SAF 226

Completed wells safety systems and safety rules

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1. Scope

1.1 Purpose of the specification

The purpose of this general specification is to define the safety requirements applicable to completed wells surface equipment (including flow-lines and injection lines) and to safety devices. Neither safety requirements for servicing of well equipment nor safety considerations incorporated in the design of the well X-mas tree and completion are covered in this specification.

In accordance with the hazard tree for production installations as per [API RP 14J](#), these measures contribute to the fulfilment of the following objectives:

- **Containment of hydrocarbon**
 - Provide the completed wells with adequate safety barriers, and means of activation if necessary,
 - Provide flow-lines and injection lines with adequate isolation and safety devices.
- **Preventing hydrocarbons ignition**
 - Provide gas detection devices,
 - Define hazardous areas and classify hazardous zones around wells.
- **Mitigation**
 - Provide fire detection devices,
 - Minimise the effects of a fire, either by position or by protection,
 - Provide means for active fire fighting.

This document follows the normal chronological activation of the different safety devices:

- Requirements for completed wells safety barriers activation means (section 4),
- Requirements for completed wells surface lines integrity (section 5),
- Requirements for the safety and control systems (section 6),
- Requirements for wellhead general arrangement for operations and well servicing activities (section 7),
- Hazard prevention and mitigation devices (section 8),
- This GS does not cover the safety of **simultaneous operations (SIMOPS)**, involving drilling or work-over operations with a rig close to other live wells. However SIMOPS principles are outlined in section 9.

1.2 Applicability

This specification is not retroactive. It shall apply to new installations (including new wells) and to major modifications or extensions of existing installations (including existing wells), onshore, and offshore. This specification is not applicable to sub-sea wells. This specification is limited to highlighting safety considerations applicable to completed development wells (exploration wells are excluded).



This GS is applicable to conventional production and injection HC or water wells, onshore and offshore. For the particular case of subsea wells, contact TDO/TEC/SBS. The particular case of air injection wells, CO₂ sequestration wells, etc. can be subject to additional considerations which are not detailed in this GS. In such cases, a specific auditable document shall be produced.

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.

Standards

Reference	Title
ISO 10497	Testing of valves — Fire type-testing requirements

Professional Documents

Reference	Title
ASME B 16.5	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B 31.3	Process Piping
API SPEC 6A	Specification for Wellhead and Christmas Tree Equipment
API RP 14C	Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms
API RP 14J	Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
IP Code, Part 15	Area classification code for petroleum for installations, part 15 of the Institute of Petroleum Model Code of Safe practice (March 1990)

**Other documents**

Reference	Title
	Statement of Requirements (SOR) Safety Concept Operating Philosophy

Total General Specifications

Reference	Title
GS EP INS 146	Design of generation and distribution of hydraulic energy
GS EP INS 147	Design and supply of wellhead control panels
GS EP PVV 142	Valves
GS EP SAF 021	Layout
GS EP SAF 216	Area classification
GS EP SAF 228	Liquid drainage
GS EP SAF 253	Impacted area, restricted area and fire zones
GS EP SAF 261	Emergency Shut-Down and Emergency De-Pressurisation (ESD & EDP)
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems
GS EP SAF 311	Rules for the selection of fire-fighting systems
GS EP SAF 312	Fire and gas detection systems
GS EP SAF 321	Fire pump stations and fire water mains
GS EP SAF 322	Fixed fire water systems
GS EP SAF 337	Passive fire protection: Basis of design

3. Terminology and definitions

There are five types of statements in this specification, the “shall”, “should”, “may”, “can” and “must” statements. They are to be understood as follows:

Shall	Is to be understood as mandatory. Deviating from a “shall” statement requires derogation approved by Company.
Should	Is to be understood as strongly recommended to comply with the requirements of the specification. Alternatives shall provide a similar level of protection and this shall be documented.
May	Is to be understood as permission.
Can	Is to be understood as a physical possibility.
Must	Expresses a regulatory obligation

Note that “will” is not to be understood as a statement. Its use is to be avoided, unless it is necessary to describe a sequence of events.

For the purpose of this specification, the following definitions shall apply:

Active Fire-Fighting	Same as Fire Protection, Active.
Annulus 0	First annulus between the production tubing and the production casing.
Area (desert)	Any area, larger than 500 km ² and where it is ensured that, over the project life-time, there will be no permanent agricultural activity, no fishery, no forest, no wild life reservation, no permanent population settlement, no road transport with traffic larger than 200 vehicles per day, no passenger transportation by railway and no industrial facility (Company).
Area (hazardous)	A hazardous area is defined as a three dimensional space in which a flammable atmosphere may be expected to be present at such frequencies as to require special precautions for the control of potential ignition sources (IP Code, Part 15). All other areas are referred to as non-hazardous areas in this context.
Area (inhabited)	All areas that do not match the criteria applicable to desert areas.
Area (restricted)	Area within the boundaries of the installation and hence under the control of Company, that is affected permanently by normal operation of the installation or exceptionally by the consequences of an emergency situation caused by a major failure (Company).
ASV (Annulus Safety Valve)	ASVs are high integrity safety valves installed on some gas lifted wells in the ‘annulus 0’ This safety valve as a similar function as a DHSV. They are controlled by the WellHead Control Panel (WHCP) and linked to the safety system (ESD).
Barrier	A “barrier” is an element of the envelope located on a potential leak path able to stop any fluid flow. Each barrier shall be designed with regard to fluid characteristics, maximum pressure and extreme temperature constraints expected at the considered barrier location.

Choke	Manual or remote operated valve used to control the well production flowrate. Remote chokes are controlled by the Process Control System.
Choke (Fixed)	A fixed choke is a flow restriction equipment used to limit the well maximum production flowrate.
DHSV (Down Hole Safety Valve)	DHSV is a generic term that includes the following type of valves: SCSSV and SSCSV.
Emergency De-Pressurisation (EDP)	Control actions undertaken to depressurise equipment or process down to a pre-defined threshold (generally 7 barg or 50 % of design pressure) in a given period of time (generally 15 minutes) in response to a hazardous situation (ISO+Company).
Emergency ShutDown (ESD)	Control actions undertaken to shutdown equipment or process in response to a hazardous situation (ISO).
Emergency Shutdown System	System of manual stations and automatic devices which, when activated, initiate installation shutdown (Company).
ESDV (Emergency ShutDown Valve)	High integrity shutdown valve, handling a hazardous fluid or a fluid having an essential function, and located at the limit of a fire zone or within a fire zone to limit hydrocarbon inventory (Company). ESDVs are controlled by the Emergency ShutDown system (ESD).
Fire and Gas (F&G) system	Safety system which monitors the temperature or the energy flux (fire), the concentration of flammable or toxic gases (gas), and initiates alarm and Shutdown functions at pre-determined levels (Company).
Fire Protection, Active (AFP)	Any fire protection system or component which requires the manual or automatic detection of fire and which initiates a consequential response (API).
Fire Protection, Passive (PFP)	Coating, cladding arrangements or a free standing system which in the event of fire will provide thermal protection to the substrate to which it is attached or to the protected area and does so independently of a requirement for human, mechanical or other intervention to initiate a response (Company from ISO and API).
Fire zone	Areas within the installation where equipment are grouped by nature and/or homogeneous level of risk attached to them. The partition into fire zones is such that the consequences of a flammable gas leak, an explosion or a fire corresponding to the worst credible event likely to occur in the concerned fire zone shall not impact other fire zones to an extent where their integrity could be put at risk (Company).
Fuel source	Same as ISO definition of "source of release" (API).
Ignition source	Source of temperature or energy sufficient to initiate combustion (API).

LMV (Lower Master Valve)	First manual valve of the X-mas tree. Always opened, the valve is closed when maintenance on the SSV or downstream equipment is required.
Pressure-containing envelope	A "pressure-containing envelope" is an assembly of barriers tight and strong enough to prevent any unwanted external release and to hold effluent at maximum WHSIP (Wellhead Shut-in Pressure).
SCSSV (Surface Controlled Sub-surface Safety Valve)	SCSSVs are controlled from the surface by the WellHead Control Panel (WHCP) and linked to the safety system (ESD). - Tubing-Retrieveable TR-SCSSV: the valve is attached to the tubing, and a workover is required for replacement. - Wire-line Retrieveable WL-SCSSV: the valve is latched into a landing nipple and can be replaced by wireline operation.
SDV (Shutdown Valve)	Automatically operated valve (generally fail to close) used for isolating a process station (API). SDVs are often referred to as Process ShutDown Valves (PSDV). The acronyms SDV and PSDV are equivalent but SDV is used in this specification because SDVs may not always be attached to a process system.
Source of release	Point from which a flammable gas, vapour or liquid may be released into the atmosphere (ISO).
SSCSV (Sub-Surface Controlled Safety Valve)	SSCSVs are stand-alone valves that are not linked to the surface safety system (ESD). These valves are either controlled by the flow (e.g. velocity valves or storm chokes) or by the pressure (e.g. gravity check valves or absolute pressure controlled safety valves).
SSV (Surface Safety Valve)	SSVs are high integrity safety valves located on the X-mas tree (Upper Master Valve) and are controlled from the WellHead Control Panel (WHCP) and linked to the Emergency ShutDown system (ESD).
UMV (Upper Master Valve)	See SSV definition above.
Well (air injector)	Used to inject air into the reservoir to achieve in-situ combustion. For safety purposes, steam wells and air injector wells are considered to be equivalent to gas wells with the exception that flammable gas detection is not required. In the absence of accurate information any well, either abandoned or belonging to another party or out of stream, shall be regarded as the most demanding in term of safety measures.
Well (eruptive)	Well which cannot satisfy the non-flowing well criteria defined below is named "eruptive".
Well (gas)	Well which produces or injects with a Gas/Liquid Ratio larger than 500 (vol./vol.).



Well (injector)	Well where fluids are flowing from surface facilities to reservoir(s).
Well (non-flowing)	A well is considered as “non-flowing” if once the injection/activation system has been de-activated, once injecting/producing bore had been bled-off to atmospheric pressure and once well mean temperature is stabilised, no flow liquid or gas can be observed at surface.
Well (oil)	Well which produces or injects with a Gas/Liquid Ratio smaller than 500 (vol./vol.).
Well (steam)	Water well where the water temperature is such that it will be in vapour phase at atmospheric pressure.
Well (water)	Well which produces or injects gas-free water, and which is perforated only in a water bearing zone with no risk of oil/gas breakthrough from a remote oil/gas bearing zone or from overlaying/underlying reservoirs.
WHSIP	Well-head Shut-in Pressure.
WV (Wing Valve)	WVs are safety valves, they connect the production flowline to the X-mas tree and are controlled from the WellHead Control Panel (WHCP) and linked to the Emergency ShutDown system (ESD).
Zone 0 hazardous area	Part of a hazardous area in which a flammable atmosphere is continuously present, or present for long periods.
Zone 1 hazardous area	Part of the hazardous area in which a flammable atmosphere is likely to occur in normal operation.
Zone 2 hazardous area	Part of the hazardous area in which a flammable atmosphere is not likely to occur in normal operation and, if it occurs, will exist only for a short period.

4. Activation of safety barriers

This specification assumes that completed wells are designed in compliance with the Company well department design requirements as described in Appendix 1.

This chapter specifies the safety requirement for the activation of completed well safety barriers.

The principal requirements relate to the number of pressure containing envelopes and safety barriers.

Eruptive wells shall at all times be equipped with two envelopes (external and internal) between the reservoir and the atmosphere.

Non-flowing wells shall be equipped with one (external) envelope between the reservoir and the atmosphere.

Eruptive wells shall be operated with two independent automated active barriers on tubing leak path, one on each envelope, capable of operating independently and simultaneously.

Non flowing wells will be operated with one active barrier (manual or automated).

The following table 1 provides the minimum envelopes and barriers required for each type of well.

Table 1: Wells envelopes and barriers

	1 Ext. & 1 Int. Envelopes	1 Ext. Envelope	DHSV (SCSSV type) (6)	ASV (ESDV type) (5)	SSV (ESDV type) (2)	WV (SSV type) (2)	GL SDV type	GL Manifold SDV type
HC PRODUCERS								
ERUPTIVE WELL without Activation	X		X		X	X		
ERUPTIVE WELL with Gas-Lift	X		X	1	X	X	X	X
ERUPTIVE WELL with ESP	X		X		X	X		
ERUPTIVE WELL with Rod Pump	X		7		8	X		
NON FLOWING WELL with Gas-Lift		X		1	10	3	10	X
NON FLOWING WELL with ESP		X			X	3		
NON FLOWING WELL with Rod Pump		X			9	X		
WATER PRODUCERS								
ERUPTIVE WELL	X		11		X	3		
NON FLOWING WELL with ESP		X				3		
GAS INJECTORS								
	X		X		X	X		X
WATER INJECTORS								
ERUPTIVE WELL	X		4			3		
NON FLOWING WELL		X				3		

At least SSV or WV

Notes:

- (1) Where applicable: Acid Gas (H₂S) or Presence of Living Quarter (< 50 m) or Urban Zone
- (2) Non Flowing Wells the external envelope barrier may be manual.
- (3) If required for SIL system qualification or by Operation (see Operating Philosophy)
- (4) A SCSSV or a Flapper type Injection Valve is required
- (5) Annulus Safety Valve not strictly considered as a safety barrier
- (6) SCSSV is a contingency solution only, subjected to derogation
- (7) The DHSV shall be installed below the rod pump
- (8) Surface BOP to close the well in case of leak at polished rod dynamic seal,
- (9) Double sealing system shall be fitted at the polished rod.
- (10) GL SDV shall be installed where no SSV barrier is installed
- (11) As required

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4.1 Down-Hole Safety Valve (DHSV)

- DHSV(s) shall be of SCSSV type only.
- Fail safe DHSV(s), SCSSV types are activated by the Safety System (ESD system).
- DHSV(s), SCSSV type shall close upon ESD-1 (fire zone ESD) or ESD-0 if any.

4.2 Surface Safety Valve (SSV)

- The Surface Safety Valve (SSV) is part of the wellhead X-mas tree, typically consisting of an automatically operated "Upper Master Valve".

- SSV(s) are fail safe and shall be activated by the safety system.
- SSV(s) shall close upon ESD-0 (if applicable), ESD-1, SD-2 and SD-3.
- SSV is considered as an ESDV and thus a local reset is mandatory.
- Production motorised chokes cannot be considered as safety valves.

4.3 Wing Valve (WV)

- An automatically operated Wing Valve (WV) shall be provided to supplement the X-mas tree SSV (automatically operated "Upper Master Valve").
- The automatically operated WV shall be fitted with an actuator linked to the ESD system following the same logic as the SSV.
- Additionally the WV can be closed voluntarily by operator via telemetry; in that case, remote opening of the WV is allowed.
- The non application of automatically operated WV(s) shall be justified in the Safety Concept based on the type of well(s) (e.g. non application could be anticipated for a non-flowing (non-eruptive) well or for a water well) and supported by documents.

4.4 De-activation of artificial lift

Any artificial lift system shall be connected to the safety system, which will de-activate it in case of an emergency. The specific causes and effects for each type of artificial lift are listed here below:

- **Gas-lift:**

In the case of direct gas-lift (injection in the annulus 0), the first surrounding annulus (annulus 1) shall be fitted with PAH and PSHH sensors. The PAH is provided for early warning purpose and is fitted with local and visible alarm. The PSHH shall trigger the well SD-3. The gas injection-line to the well shall be equipped with a surface gas injection SDV that shall close in case of SD-3.

- **Down hole centrifugal pump:**

These wells should generally be fitted with a PSHH sensor, pump overload and underload, high temperature and vibration trips, which shall trigger the well individual shutdown (SD-3) and open the circuit breaker in the MCC. The list of inputs triggering SD-3 may nevertheless vary and shall therefore be determined together with the pump Vendor.

- **Positive displacement pump:**

Same principles as for a centrifugal pump, plus a local emergency push button that shall trip the motor or engine. For personnel protection purposes, the area around the pump and its motor/engine shall have a restricted access.

5. Surface lines integrity

The design of surface lines shall comply with the minimum requirements of [API RP 14C](#), offshore and onshore. The hereafter requirements are intended to clarify or complement use of [API RP 14C](#) by Company.

The number of instruments which are considered as weak points shall be minimised in accordance with TDO/TEC/INS.