

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 100

Overall Instrumentation Philosophy

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1. Scope

The specification defines the overall Instrument philosophy to be adopted for onshore and offshore oil and gas installations.

It serves as an introduction document defining the optimised instrument requirements. This specification is not exhaustive in its own right and shall be used in conjunction with the detailed requirements defined in the respective General Specifications listed in the reference documents.

2. Reference documents

The design shall satisfy the requirements and regulations of the country of installation and the standards referred to in this specification.

Where national regulations exist, their provisions and those of the standards and codes to which they refer shall apply, supplementing or amending the provisions of this document.

The reference documents listed below form an integral part of this General Specification.

External Documents

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

Reference	Title
API RP 520	Recommended practice for the design and construction of pressure-relieving systems in refineries
API STD 526	Flanged Steel Pressure Relief Valves
ASME BPVC Section I	Rules for Construction of Power Boilers
ASME BPVC Section VIII	Rules for Construction of Pressure Vessels
ASME PTC 19.3TW	Thermowells
ASTM D2863	Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
Directive 2014/34/EC	European Directive 2014/34/EU (26/02/2014) on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres
EEMUA 191	Alarm systems - A guide to design, management and procurement
IEC 60079-14	Explosive atmospheres - Part 14: Electrical installations design, selection and erection
IEC 60331-21	Tests for electric cables under fire conditions. Circuit integrity - Part 21: Procedures and requirements. Cables of rated voltage up to and including 0.6/1.0 kV

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Reference	Title
IEC 60332-3-22	Tests on electric and optical fibre cables under fire conditions - Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A
IEC 60364 (Parts 4-44; 5-54)	Low-voltage electrical installations - Parts 4-44; 5-54
IEC 60754-1	Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content
IEC 61000-5-2	Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling
IEC 61034 (All parts)	Measurement of smoke density of cables burning under defined conditions - All parts
IEC 61511 (All parts)	Functional safety - Safety instrumented systems for the process industry sector - All parts
IEC 61892 (Parts 6; 7)	Mobile and fixed offshore units - Electrical installations - Parts 6; 7
IEC 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable control systems
IEC 62443-2-1	Industrial communication networks - Network and system security - Part 2-1: Establishing an industrial automation and control system security program
IECEX	IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEX System)
IOGP report 547	Hydrocarbon process single and multi-layer level measurement - Recommended Practice
UL 1581	Reference standard for electrical wires, cables, and flexible cords (partial)

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP EXP 131	Design and installation of Process Data Server - Creation and administration of Asset Model using Field Share method
GS EP EXP 139	Alarm Management
GS EP INS 000	Contractor Document Requirements
GS EP INS 101	Instrumentation Design
GS EP INS 102	Instrumentation Identification

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Reference	Title
GS EP INS 103	Instrument Database Management
GS EP INS 104	Generation and Distribution of Instrument Air and Instrument Gas
GS EP INS 106	Instrument Installation
GS EP INS 108	Instrumentation for the design of plant rooms and control rooms
GS EP INS 109	Instrument cabinets
GS EP INS 110	Instrumentation for package units
GS EP INS 111	Design and supply of liquid custody transfer metering units
GS EP INS 112	Design and supply of gas custody transfer metering units
GS EP INS 114	Instrument Tubing and Fittings
GS EP INS 115	Instrument Earthing
GS EP INS 116	Instrument Cables
GS EP INS 120	Control and Choke Valves
GS EP INS 125	Safety Relief Valves and Rupture Discs
GS EP INS 131	Standard Functions and Functional Analysis Development Requirements
GS EP INS 134	Design and supply of integrated control and safety system
GS EP INS 135	Cybersecurity Requirements for Industrial Information Systems (SII)
GS EP INS 137	On/Off Valve Control Panels and Actuators
GS EP INS 138	Electric Actuators for On/Off Valves
GS EP INS 140	Instrumentation for monitoring packages
GS EP INS 141	Analysers
GS EP INS 143	Fire and Gas Detectors and Associated Detection Systems
GS EP INS 146	Generation and Distribution of Hydraulic Energy
GS EP INS 147	Wellhead Control Panels
GS EP INS 150	Design method for system configuration - Standard functions
GS EP INS 156	Human Machine Interfaces (HMI)
GS EP INS 158	I/O Assignment Principles
GS EP INS 196	Input and Output Standard Functions
GS EP INS 197	Process Standard Functions
GS EP INS 198	Safety and Fire & Gas Standard Functions
GS EP INS 307	POB, E-Mustering and E-Tracking

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Reference	Title
GS EP INS 309	Access Control Systems
GS EP INS 900	Instrument Hook-up diagrams
GS EP PVV 154	Ball valves
GS EP PVV 155	Gate, Globe and Check Valves
GS EP SAF 227	Safety rules for fired heaters
GS EP SAF 261	Emergency Shutdown and Emergency Depressurisation (ESD & EDP)
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems
GS EP SAF 312	Fire and Gas detection
GS EP TEC 007	Obsolescence and Lifetime Cycle Management
GS EP TEC 260	HIPS Design, Implementation and Life cycle

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.
Company	TOTAL E&P or any TOTAL E&P subsidiary.
Contractor	Any Company TOTAL E&P has signed a Contract with for the Engineering, Procurement, Construction, and Installation of a part of a project.
Vendor	The Package Vendor sub-contracted by the Contractor or by Company.
Package	Prefabricated process or utility self-contained unit, generally able to operate on its own, supplied fully tested and ready for immediate installation

3.1 Abbreviations

ATEX	Atmosphere EXplosive
CCR	Central Control Room
DCS	Distributed Control System

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DMCMS	Digital Management Condition Monitoring System
DVT	Design Validation Test
ECS	Electrical Control System
ESD	Emergency Shut-Down (SIS)
EWS	Engineering Work Station
FAT	Factory Acceptance Test
FDS	Functional Design Specification
FGS	Fire and Gas System (SIS)
GPA	General Plant Alarm
HIPS	High Integrity Protection System
HMI	Human Machine Interface
HP	High Pressure
ICSS	Integrated Control and Safety System
IE	Instrument Earth
IPE	Instrument Protective Earth
ISE	Intrinsically Safe Earth
IMS	Instrument Management System
I/O	Inputs/Outputs
IS	Intrinsically Safe
LSZH	Low Smoke Zero Halogen
MCC	Motor Control Centre
MTTR	Mean Time to Repair
MWS	Maintenance Work Station
OS	Operating System
OTS	Operator Training Simulator
OWS	Operator Work Station
PAGA	Public Address General Alarm
PAPA	Prepare to Abandon Plant Alarm
PB	Push Button
PCS	Process Control System
PDS	Process Data Server
PLC	Programmable Logic Controller
PSS	Process Safety System (SIS)

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PSV	Pressure Safety Valve
RTU	Remote Telemetry Unit
SIE	Enterprise Information System
SII	Industrial Information System
SIL	Safety Integrity Level
SIS	Safety Instrumented System
SOE	Sequence of Events
SVTS	Smart Valve Test System
SWS	SOE Work Station
UCP	Unit Control Panel
USS	Ultimate Safety System (SIS)
VAS	Vibration Analysis System

4. Introduction

Instrumentation requirements are based on international norms and standards. As such norms are not exclusive and contain many choices, some normative others informative, then Company has developed a set of General Specifications to define the optimised requirements covering the design, procurement, construction, testing and operation of Instruments and Instrument systems. These General Specifications are based on Company's experience in the development and operations of oil and gas installations both onshore and offshore. They complement the international norms and standards and clarify how they should be applied.

The Instrumentation General Specifications are organised into 5 principle sections as detailed within Appendix 1.

- Instrument Design
- Instrument Construction
- Instrument Systems
- Instrument Engineering
- Instrument Packages.

The General Specifications are designed to be complemented by Project Particular Specifications, as defined in **GS EP INS 000**, to take account of specific project requirements while the core needs and philosophies remain standard in order to achieve a Safe, Simple, Robust Instrument design and installation.

5. Instrument General Principles

Instruments are provided to ensure safe operations of the plant. They shall be designed to be safe, simple and robust ensuring segregation and independence between monitoring/control functions and safety functions.

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5.1 Instrument Definition

The term “Instrument(s)” includes all devices that are used directly or indirectly to measure or control a variable. This includes primary element (sensors), transmitters, final control elements, computing devices, annunciators, switches and push-buttons, related to process, utilities, safety and fire & gas functions.

5.2 Environmental Conditions

Instruments and instrument equipment shall be designed suitable for permanent operation under the prevailing environmental conditions of the installation location or as specified by project particular design conditions.

It should be noted that the environmental conditions at the fabrication yard may be different to those of the final site location. Therefore, the fabrication yard storage and installation conditions shall also be taken into account.

5.3 Instrument Architecture

The standard instrument loop architecture consists of field instruments connected to junction boxes, which are in turn connected to marshalling cabinets by means of multi-cables. Signals are then routed to the appropriate instrument control or safety system.

In general, marshalling cabinets and system cabinets are installed indoors, in technical rooms when junction boxes are installed in the field and outdoors.

Alternative instrument loop architecture is with the use of external Remote I/O. This alternative consists of instruments connected individually to remote I/O units located externally within the field. The remote I/O is then connected via a network to appropriate controller of the system located in the technical room.

Remote I/O's are considered as “smart junction boxes”. They consist of I/O modules, power supplies, communication bus interface and field terminals enclosed in boxes or cubicles according to the number of sensors or actuators they have to cope with.

Particular care is required with remote I/O units to ensure that they meet the SIL and hazardous area requirements and are suitable for the environment in which they are located.

A third alternative architecture is with the use of wireless instruments. However, wireless instrument architecture shall be studied on a case by case basis and is subject to Company approval. Wireless instruments are not permitted for control and safety functions (PCS, PSS, ESD, FGS, HIPS, USS and UCP), time critical applications and any other critical safety functions.

Safety and control/monitoring functions shall be performed by independent and autonomous instruments each with their independent process connection. Consequently alarm and trip thresholds shall not be derived from the same instrument.

Instrumentation signals shall be segregated according to their type and ensuring that the control/monitoring remains fully independent of the safety function.

The systems themselves shall be fully independent between control/monitoring and safety functions.

Further details are defined in [GS EP INS 101](#) and [GS EP INS 134](#).

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5.4 Hazardous Area Protection

All equipment must comply with the requirements of the specific hazardous area where they are installed.

ATEX European [Directive 2014/34/EC](#) shall strictly apply in European Countries and associated countries (e.g. Norway, Iceland).

ATEX European [Directive 2014/34/EC](#) or [IECEX](#) standards shall apply in other countries.

All field instruments and instrument equipment (i.e. Junction Boxes, Outdoor Control Panels/Cabinets etc.) shall be certified for zone 1.

Field instruments and instrument equipment not certified for zone 1 shall be de-energised in case of gas detection.

All instruments shall be installed in accordance with [IEC 60079-14](#) regulations. An IS loop calculation sheet shall be submitted for each installed IS instrument.

Technical rooms are generally pressurised and hence shall be considered as safe areas.

Detailed requirements of hazardous area protection are defined in [GS EP INS 101](#).

5.5 Instrument Standardisation

Instrument standardisation requirements are addressed during basic engineering and shall take into consideration the project contractual strategy (i.e. different EPC Contractors).

Instrument standardisation should be considered for the whole plant, including packaged units, i.e. same technology, supplier and model for the same use.

Instruments shall be selected only from approved vendors.

5.6 Instrument Identification and Labelling

All instruments shall be identified by a unique tag number as defined in [GS EP INS 102](#).

Instruments shall be labelled with this tag number, generally on the instrument itself as well as the location as defined in [GS EP INS 101](#).

5.7 Instrument Installation Guideline

All instruments shall be installed in accordance with [GS EP INS 106](#) and [GS EP INS 900](#).

5.8 Instrument Tubing and Fittings

Onshore instrument tubing shall be made of AISI TP 316L stainless steel grade. However, in specific environmental conditions which could lead to chloride stress corrosion cracking or pitting, a higher grade of material shall be used.

Offshore and nearshore (marine environment) instrument tubing shall be made of AISI TP 904L or 25Cr Superduplex stainless steel grade.

Specific tubing materials for seawater service shall be used.

For applications designated by Company as severe corrosive or toxic, then other suitable materials shall be proposed for Company approval.