

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 110

Instrumentation for package units
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1. Scope

This document covers the works, equipment, services and responsibilities that shall be provided or executed by the package Vendor for instrumentation associated with major mechanical or process equipment, systems or units.

2. Reference documents

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 supplements, is the latest revision published at the effective date of this document.

Reference	Title
ATEX European Directive 94/9/EC	European Directive on the approximation of the Laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
European Directive 2004/108/EC	European Directive on the approximation of the Laws of Member States relating to electro-magnetic compatibility (EMC)
IEC 61000-5	Sections related to the Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines
IEC 61131-3	Programmable controllers - Part 3: Programming languages
IEC 61508	Parts related to the Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61511	Parts related to the Functional safety - Safety instrumented systems for the process industry sector
IEC 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
IECEX	IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEX 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 ELE 011	Electrical requirements for packaged units
GS EP EXP 131	Design and installation of Process Data Server
GS EP INS 000	Minimum Contractor Document Requirements

Reference	Title
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP INS 102	Instrumentation identification
GS EP INS 103	Instrumentation Database Management
GS EP INS 107	Design and installation of instrumentation links
GS EP INS 120	Control and Chokes 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	Cyber Security requirements for design and supply of ICSS and Package Systems
GS EP INS 137	On/off valve control panels and actuators functional and construction requirements
GS EP INS 150	Design method for system configuration - Standard functions
GS EP INS 198	Safety and Fire & Gas Standard Functions
GS EP INS 900	Instrument hook-up diagrams
GS EP MEC 292	Rotating Machines Packages Installation Requirements
GS EP SAF 227	Safety rules for fire heaters
GS EP SAF 261	Emergency Shutdown and Emergency De-Pressurisation (ESD & EDP)
GS EP SAF 312	Fire and Gas detection systems
GS EP TEC 007	Obsolescence and Lifetime Cycle Management

3. Definitions and abbreviations

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 or package unit	Prefabricated process or utility self-contained unit, generally able to operate on its own, supplied fully tested and ready for immediate installation.

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CCR	Central Control Room
DMZ	Demilitarized Zone
ESD	Emergency Shut Down system
EPC	Engineering Procurement Construction
EWS	Engineering WorkStation
FAT	Factory Acceptance Test
FGS	Fire and Gas System
FTA	Field Termination Assembly
HIPS	High Integrity Protection System
HMI	Human Machine Interface
ICSS	Integrated Control and Safety System
IMS	Instrument Management System
MCC	Motor Control Centre
MTTR	Mean Time To Repair
OS	Operating System
PCS	Process Control System
PDS	Process Data Server
PLC	Programmable Logic Controller
PSS	Process Safety System
SAT	Site Acceptance Test
SIE	Enterprise Information System
SII	Industrial Information System
SIL	Safety Integrity Level
SIS	Safety Instrumented System (i.e. PSS, ESD, FGS)
SOE	Sequence Of Event
UCP	Unit Control Panel
UPS	Uninterruptible Power Supply
VDU	Video Display Unit

4. Instrumentation and control philosophy

4.1 Life Cycle and Obsolescence Management

Facilities are typically designed with an expected design life in the order of 25 years. It is not practical to achieve such a design life for electronic based equipment without the requirement for upgrading.

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UCP design shall therefore take into account the requirement that the electronic based systems and associated softwares will have to be upgraded during the design life of the facilities. These requirements shall be incorporated in the Basic Engineering technical documents.

UCP equipment scope shall be given specific attention to ensure all UCP equipment, components, software and individual elements and the respective running tools, test equipment, software and human skills can be maintained or replaced such that the original function and integrity of the package unit can continue in an uninterrupted manner for the field life.

Strategy for managing obsolescence needs to be regularly updated as an integral part of the core functions

- Design and development
- Sourcing and production
- In-service sustainability
- Vendors support.

An obsolescence dossier shall be established in accordance with **GS EP TEC 007** and continuously updated during the life cycle time (refer to Appendix 30 - Obsolescence Dossier).

The obsolescence dossier will consider the complete life cycle including:

- Bid stage
- Design phase
- Project delivery phase
- Operation & maintenance phase.

The Vendor shall detail his lifecycle management strategy focusing on product obsolescence, support options and further migration alternatives.

Package Vendor shall guarantee that:

- UCP components (including software and hardware) shall be fully supported and available over a period of at least 15 years after the SAT
- Maintenance services including availability of engineering services shall be available to support the UCP during the plant life time.

The design will include provisions to allow for an upgrade to the electronic systems to be performed with minimal disturbance to the process and utilities. Such provisions will typically include:

- Tie-in points for the future new equipment, while the old electronics are still functioning
- Avoidance of common components within the UCP for management of duty/stand-by equipment.

4.2 Package type definition

Basically, four types of packages shall be considered:

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4.2.1 P1 type packages

The package is delivered with its instruments but without cables and cable ducts.

This type corresponds to packages with few instruments.

These packages are fully controlled by the ICSS.

The Vendor shall provide the Contractor with detailed documentation. Contractor is responsible for further integration of the P1 package into the installation and its functionality.

4.2.2 P2 type packages

The package is equipped with its instruments, cables and cable trays. Instruments are wired and connected up to junction boxes, located at the edge of the package skids.

This package type is foreseen for packages with many instruments but which control and safety logic is simple and does not exist as standard supply by the Vendor or for packages considered as integral part of the facility process functions.

These packages are fully controlled by the ICSS. The Vendor shall provide the Contractor with a detailed functional analysis to be forwarded to the ICSS Supplier. The Vendor shall be involved in the ICSS FAT to validate the control and safety algorithms.

4.2.3 P3 type packages

They are similar to P2 type packages, but control and shutdown functions are implemented in a dedicated packaged unit control system (UCP), with associated cabinets as part of the package scope of supply, including all relevant control equipment.

Control logic for a P3 type package should not require specific development and package Vendors should propose their own standard control algorithms.

The UCP always includes an automated system, performing total or partial control of the package, with its HMI. Multi-parameters monitoring devices, e.g. local hand controlled panels with buttons, switches and lamps, shall not be considered as UCP's.

P3 type package shall generally be supervised and controlled at a higher level by the ICSS. In this case, normal operations shall be controlled from the ICSS ("Remote" mode) but operations in "Local" mode shall be possible at the UCP. Full access to all package parameters shall only be possible from the UCP.

4.2.4 P4 type packages

P4 packages are systems comprising of their own instruments and Unit Control panel for the sole purpose of monitoring equipment, structures, pipelines, umbilicals, risers, reservoirs as well as environmental conditions.

These packages shall not perform any control or safety functions related to the supervision, control and safeguarding of the process plant and utility systems.

Generally measurements are collected to monitor integrity of equipment over a long term basis. The data can then be analysed equipment integrity purposes to allow longer term analysis.

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Those measurements or data are not made available to the ICSS Operator Work Stations (OWS). Some P4 packages may, on an exceptional basis, require to alert operators to a specific event. This will be carried out by hardwired signals to the PCS.

Systems such as Overall Flow metering System, Vibrations Analysis System... shall not be treated as P4 packages, since they are based solely on software treatment of process & condition measurements.

Specific requirements applying to P4 type packages are addressed in § 8 of this Specification.

Refer to Appendix 7 for examples of some P4 type packages.

4.3 Remote Maintenance and Diagnostic (RMD)

According to project specific requirements, vendors may require to have access to data from the SII domain remotely, from outside the Company SIE network for maintenance or diagnostic purposes. All remote access shall require a specific study which shall be subject to approval by Company RSSC.

There are 2 types of Remote Maintenance and Diagnostic access:

- **Type 1**

Remote Maintenance by monitoring of specific plant data for supervision and analysis purposes (permanent connection and read only).

- **Type 2**

Remote Diagnostic for troubleshooting, diagnostic or administrative purpose (Antivirus Patch, COTS update...). This access shall be limited in time (non permanent connection read/write function).

Remote Access cybersecurity protection means shall be provided with the minimum following requirements:

- **Proof** Strong Authentication - Each Vendor that connects shall be authenticated with a PKI certificate issued by Company
- **Confidentiality** All flows crossing public networks (e.g. Internet) shall be encrypted
- **Integrity** Vendor PC conformity to Company requirements (to connect to Company security gateway, the Vendor PC shall have a supported antivirus program running, with virus signatures no older than 60 days).

The general principle is that direct connections between the systems within the SII domain and the outside world via Internet for any purpose through the use of modems etc are forbidden.

The remote vendor shall gain access to Company SIE network via Company DMZ (i.e. Total Connect).

The remote vendor shall not have direct access to SII but access via intermediary servers.

Any form of remote maintenance or diagnostics on Safety Instrumented Systems (PSS, ESD, FGS, HIPS) is forbidden.

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Type 1 access is split into 2 sub-types:

- **Type 1a** access shall be carried out using the PDS/PI. Data will be made available to PDS server on SIE. Remote access will therefore collect data from the PDS server.
- **Type 1b** access shall be used in cases where PDS/PI cannot be used. For this sub-type a specific remote access server shall be installed in SII/SIE DMZ. This RMD server will receive data from the system within SII domain. Remote access vendor will then be able to communicate with the RMD server through an SSL connection via Company DMZ (Total Connect).

Type 2 access shall only be given to Vendor with specific means and procedure. These means and procedure shall allow site personnel to have a permanent and full control of the remote access operation, initiation and stop. Logging of all operations shall be performed.

A specific remote access server shall be installed in SII/SIE DMZ. This RMD server will receive/transmit data from/to system within SII domain. Remote access vendor will then be able to communicate with the RMD server through an SSL connection via Company DMZ (Total Connect).

Refer to Appendix 6 - for the general architecture and to [GS EP INS 135](#) for additional requirements.

5. General instrumentation principles

5.1 Instruments

Packages are equipped with all their instruments, necessary piping and accessories for process connection, cables and cable routings, according to their classification.

The packages instrumentation shall be uniform with the project general instrumentation, i.e. same technology, Manufacturer and model for the same use.

The instruments shall comply with [GS EP INS 101](#) requirements and be installed according to [GS EP INS 900](#) requirements.

The instruments and instrumentation functions shall be identified according to [GS EP INS 102](#).

Actuated on-off valves shall comply with [GS EP INS 137](#) requirements.

Actuators with comply with [GS EP INS 101](#) requirements.

Control and choke valves shall be selected and supplied in compliance with [GS EP INS 120](#) requirements.

Safety relief valves and rupture discs shall be selected and supplied in compliance with [GS EP INS 125](#) requirements.

The use of on-off sensors (switches) for control and safety functions is not permitted: all process sensors shall be analogue, with HART protocol whenever available.

Sensors and final elements for control and safety functions shall be segregated; dual function is not permitted in order to avoid common-mode failures.

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5.2 Area classification/protection

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

[ATEX European Directive 94/9/EC](#) shall apply in European Countries and associated countries (e.g. Norway, Island).

[ATEX European Directive 94/9/EC](#) or [IECEx](#) standards shall apply in other countries as per project specification(s) or existing facility specifications.

All field instruments shall be certified for zone 1.

Field instrument/equipment not certified for zone 1 shall be de-energized in case of gas detection.

For category 3 equipment, as per ATEX European Directive classification, certification by Manufacturer is not accepted. A "Statement of compliance" shall be delivered by a Notified Body

Preferred protection methods are Ex d, Ex e, Ex i, Ex m, Ex me according to IEC standards. Use of protection mode Ex p and Ex n shall be limited to specific applications and submitted to Company approval.

The selected project protection method shall apply to the packaged units.

The enclosures related certification shall consider all internal components including additional parts for possible extension.

Intrinsically safe circuits shall be installed in accordance with IEC regulations. An I.S. loop calculation sheet shall be submitted for each installed IS instrument.

Technical rooms shall be pressurized and so be safe areas.

5.3 Cabling

For all types of packages, when a special type of cable is required (i.e. fibre optic, non-standard multicore arrangement cables, coaxial, etc) it shall be specified and provided by the Vendor.

The length from package skid edge to the final connection point shall be calculated by the Contractor. Vendor shall verify this length is compatible with the technical requirements.

5.3.1 P1 packages

Junction boxes are not included in the package supply.

Instrument shall be connected to the plant junction boxes as defined by the Contractor.

5.3.2 P2 packages

Instruments within the package shall be wired and connected up to junction boxes located at the edge of the package skid. All cables shall be run on cable trays.

Junction boxes shall be grouped per signal type on steel frames. Signals segregation shall be as specified in [GS EP INS 107](#).

Junction boxes shall be accessible from the ground level and their arrangement shall allow easy access for installation and wiring of multi-cables.

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The cables between the junction boxes and the marshalling cabinet shall be specified, provided and installed by the Contractor.

5.3.3 P3 packages

In addition to P2 packages requirements, P3 packages comprise the marshalling terminal strips, mirror of the package junction boxes, and the Field Termination Assemblies, mirror of the I/O cards.

Cross-wiring between the marshalling panels and the Field Termination Assemblies (FTA's) shall be done by the Vendor.

As an alternative and in order to minimize UCP size and installation works, remote I/O's can be used subject to Company approval.

5.3.4 P4 packages

Refer to paragraph 8.

5.4 Instrument air/gas and hydraulic energy distribution

Whatever the type of energy, the package shall be fed from a single connecting point. Internal distribution shall be arranged from this delivery point to the different customers.

When instrument gas is used, instruments exhausts shall be collected to a common vent line which shall be different from any process vent line. Hydraulic oil individual exhausts shall also be piped to a common return header. Both gas and hydraulic return headers shall be routed to flanged connections at skid edge.

Particular attention shall be paid by Company, Contractor and Package Vendor concerning the standardization of size system (metric or imperial) and Manufacturer of instrument tubing and fittings. Size system and Manufacturer are subject to strict single source standardization throughout the entire production facility for reasons of safety (risk of incidents due to mixed systems and non-interchangeable components), stock and maintenance. For long lead items being procured before EPC Contract award, the package bid and Purchase Order shall make provisions for post-contract definition of size system and Manufacturer for instrument tubing and fittings.

5.5 Power supply

5.5.1 P1 and P2 packages

The instrumentation on P1 and P2 packages shall be powered from the ICSS.

5.5.2 P3 packages

Electrical design shall comply with the requirements of **GS EP ELE 011**.

5.5.2.1 Power conversion and distribution

The Project Basic Engineering shall define the voltage source type(s) distributed to the UCP and associated earthing regime (i.e. IT, TT or TN-S, of which IT is the default regime offshore).

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Unless specified differently by the project specifications, all packages shall be designed to be fed by:

- 2 off independent AC UPS power supplies (designated UPS-A and UPS-B)
- 1 off normal AC power supply.

The UPS power supplies shall be used in a 2 x 100% configuration serving all control, safety related equipment, while the normal power supply shall be used for non-critical equipment such as lighting, power sockets, ventilation and heating (unless considered critical).

The incoming UPS power feeders shall not be bonded together: a strict galvanic separation must be ensured.

Generally, HMI will be fed by one of UPS sources.

The Package Vendor shall provide all necessary equipment for power conversion from AC UPS, isolation and distribution of any other voltage level required for the package or the UCP.

The 0 and 24 VDC power rails for control equipment and instrumentation shall be fed by both UPS feeders via dedicated DC/DC or AC/DC power convertors; being bonded together using decouple diodes between power convertors and DC power rails.

Isolation transformer/converter should be provided in the UCP on the incomers since the provided UPS AC voltage source is of a floating type.

The package instruments shall be powered with 24V DC referenced to earth from the UCP.

All power supplies/converters and miscellaneous associated components shall be of the industrial type and DIN rail mounted.

5.5.2.2 Protection

Each power feeder to the UCP shall be powered via dedicated breakers and protection circuits in order that no single system component failure could cause loss of power supply to other components. The two power convertors feeding the common DC power rails shall be bonded together using separate decouple diodes, rated minimum 100% each. Single devices containing both decouple diodes are not permitted; separate decouple diodes with heat sink and fault contacts shall be used.

The design of the electrical distribution shall include the short circuit and selectivity calculations.

Power supply and distribution failures shall be alarmed, logged and transmitted to the ICSS as a single general cabinet power failure alarm, grouping:

- Fault contact for each power convertor
- Fault contact for each decouple diode
- Trip contact for each circuit breaker
- Trip contact for earth leak detector.

I/O and system components power distribution shall be designed to avoid common mode failure.

Each I/O module power supply shall be individually protected.

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5.5.2.3 Generic package 24 VDC power supply & distribution diagram

The above-mentioned power supply, conversion and distribution principles related to 24 VDC powered equipment are summarized in the generic power supply diagram in Appendix 4.

24Vdc consumers within the UCP will each be protected by individual circuit breakers.

5.6 Earthing

Earthing of package instrumentation and associated equipment, field and technical room mounted, shall be in accordance with international rules and practices including [IEC 61000-5](#) and [European Directive 2004/108/EC dated 15 December 2004](#), with [GS EP INS 107](#) and with Appendix 4 of this specification.

5.7 Fire and gas

5.7.1 P2 and P3 packages

When required by project documents, fire and gas detection and associated actions (e.g. fire extinguishing) shall be supplied with the package.

Fire and gas signals can be processed either by the ICSS or by the UCP as defined in the project specifications.

When processed by the UCP, a dedicated SIL 2 rated logic solver shall be selected.

Criteria for selecting the fire and gas detectors are given in [GS EP SAF 312](#).

5.8 SIL calculations

SIL calculations shall be required for safety instrumented loops. All components within the loop (e.g. instrument, relay, FTA, etc.) shall be included within the calculation and verified that they meet the SIL requirements.

Calculations shall be validated by a third party approved by Company.

6. Unit Control Panels

This section applies to P3 type packages only.

The package control system shall be PLC based and shall perform the following functions:

- Process control
- Parameters monitoring and associated shutdown actions.

Additional functions will be also performed as per project specifications, such as:

- Supervision and data archiving functions
- Sequence Of Event recording
- Printing facilities
- Maintenance functions & diagnostics

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- Performance monitoring
- Vibrations monitoring.

The UCP shall include marshalling and PLC cabinets.

The UCP shall integrate as much as possible all main control with HMI and subsystems such as anti-surge control, load control and vibrations monitoring. All HMI and subsystem controllers shall be panel-mounted. Normally there shall be no loose supplied items (such as printer, workstation, etc), except for the engineering workstation laptop, unless clearly defined in the project specification.

Control and safety functions may be combined into one PLC but all sensors, final elements, cabling, junction boxes shall be segregated; dual functions for sensors and final elements are not permitted.

The UCP will generally be located inside a pressurized technical room, thus considered as a safe area. Refer to the project environmental specification for further information about ambient conditions in the technical room.

When installed outside, in a process zone, the UCP shall be certified for the relevant hazardous area.

Refer to the project environmental specification and hazardous areas layout drawings for further information.

Depending on the complexity and required functionality of the package, the UCP may be composed of several PLC's and display units.

6.1 Logic solvers

6.1.1 Programmable Logic Controllers

The type (Manufacturer and model) of PLC shall be uniform with the other PLCs provided for the project and must be submitted to Company for approval.

The PLC shall be supplied with its own engineering workstation and all tools, hardware (including all necessary cables) and software with required licenses, necessary for control, configuration, development and maintenance.

For large packages, when a great number of information must be exchanged, the preferred solution is a package control system based on the same type of controller than the main ICSS, so as to be considered as a node of the ICSS network. In such cases, Vendor has the technical responsibility of the package control system and of its interface integration and definition in the ICSS. Special attention shall be paid to the firmware release for all modules.

6.1.2 SIL requirements

Generally, package control systems comprise only one PLC dealing with all the process control and shut-down functions.

This PLC shall be 3rd Party certified suitable for treating SIL 2 safety instrumented functions.

The PLC safety manual shall be followed for safety instrumented functions, which have been identified by package SIL assessment. Therefore, the Package Vendor shall apply the specific